

DANISH METEOROLOGICAL INSTITUTE

TECHNICAL REPORT

00-09

**Evaluation of the HIRLAM Surface Analysis
Scheme for 2 metre Temperature and Relative
Humidity by Comparison with AMIS Gridded
Observations**

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Preface

This report presents a comparison of gridded temperature and humidity fields from the DMI AgroMeteorological Information System (AMIS) with short-term forecasts from the DMI-HIRLAM (High Resolution Limited Area Model) system and fields generated using the HIRLAM optimum-interpolation surface analysis scheme. The investigation was carried out at DMI in 1999 as part of a joint project with Danish agricultural organisations on IT and decision support systems in agriculture, “Informatik og Beslutningsstøttesystemer i Jordbruget” (INF96-1), financed in part by the Danish Ministry of Food, Agriculture and Fishery.

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DMI, March 2000

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1. Introduction

1.1 General

A central component of DMI's AgroMeteorological Information System (AMIS) is the interpolation of observed meteorological data to the 10 by 10 kilometre AMIS grid. As has been documented elsewhere (Hilden and Hansen, 1998), the AMIS observational data are generally of high quality, but do contain certain systematic errors, probably stemming in part from the quite simple, isentropic interpolation scheme used to calculate the data from the raw observed values.

An obvious possibility for improving the AMIS observational fields would be to exploit the methods of a state-of-the-art numerical weather prediction system. In the analysis and initialisation parts of such a system, the three-dimensional state of the model atmosphere is adjusted towards measured values in a manner which respects and makes use of the physical and dynamical laws that govern and constrain the (model) atmosphere. Likewise, the influence of local surface characteristics (represented in the model) on the atmospheric conditions near the ground are taken into account through the model parameterisations of the interactions between the atmosphere, the sea or land surface (including vegetation), and the layers below the surface.

The present study addresses the question of how and to what extent the gridding of observations in AMIS might benefit from a closer connection to the Danish operational numerical weather prediction system, the DMI-HIRLAM (High Resolution Limited Area Model) system. In the current versions of DMI-HIRLAM, pressure observations from ground stations enter into the analysis and initialisation procedures implicitly, through their (modelled) influence on the lowest model layer, but other parameters measured at ground stations situated on land are not used. However, a separate HIRLAM surface analysis package may be run on top of the analysis and forecast modules to produce two-dimensional gridded fields of 2 metre temperature and relative humidity (and, if desired, 10 metre wind) from raw observations, using HIRLAM fields as a first guess in an optimum interpolation procedure. This study is a comparative evaluation of 2 metre temperature and relative humidity fields generated by AMIS, the operational HIRLAM model and the HIRLAM surface analysis scheme.

1.2 Methods and Data

The investigation was performed for a period of four months for which a homogeneous set of archived HIRLAM forecast data was available: April 21, 1999, 06 UTC, through August 19, 1999, 00 UTC. Four observation hours per day were considered: 00, 06, 12 and 18 UTC. The data sets compared were:

- Recalculated AMIS observation fields of 2 metre temperature and relative humidity;
- Archived 6-hour forecasts of these parameters generated by HIRLAM-D, the operational 5 km resolution version of the DMI-HIRLAM model;

- Surface analyses of the same parameters performed with the HIRLAM surface analysis scheme and with the HIRLAM-D forecasts providing the first-guess fields;

16 SYNOP and automatic climate stations were selected as verification stations (Figure 1.2.1 and Table 1.1); measurements from these were left out in the surface analysis and in the AMIS recalculations.

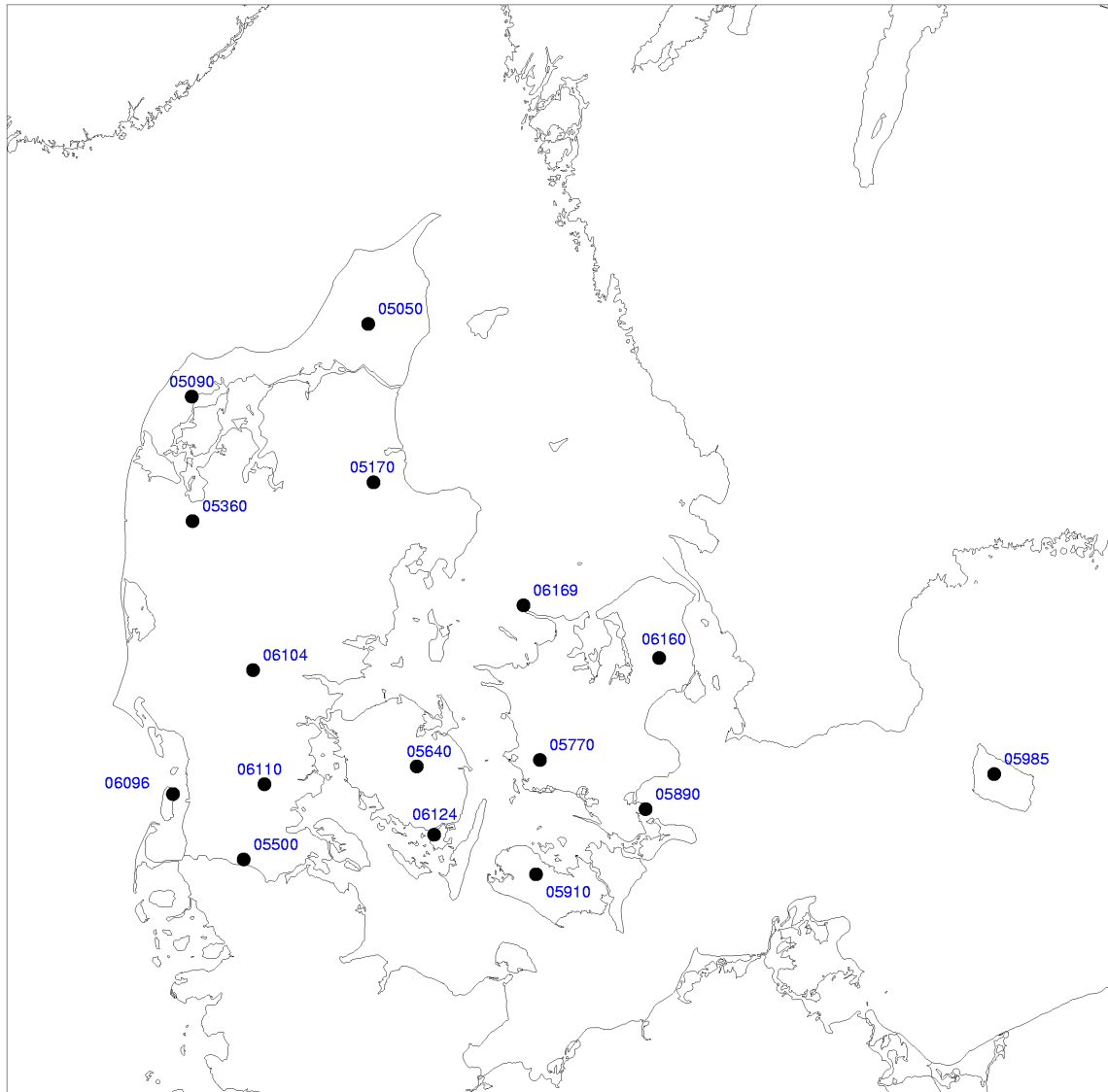


Figure 1.2.1 Stations used in verification

The evaluation was done for each station and each observation hour on monthly samples using standard meteorological verification measures. In addition to the statistical verification, a qualitative validation was carried out for three days with different characteristic weather types.

05050	Åholm
05090	Silstrup
05170	Hald
05360	Mejdrup
05500	Store Jydevad
05640	Årslev
05770	Flakkebjerg
05890	Bønsvig Strand
05910	Abed
05985	Klemensker Ø
0696	Rømø
06104	Billund
06110	Skrydstrup
06124	Tåsinge
06160	Værløse
06169	Gniben

Table 1.1 Stations used in verification

1.3 Outline

The report is organised as follows:

Chapter 2 contains brief descriptions of the three production systems: AMIS, the DMI-HIRLAM system, and the surface analysis scheme. Chapter 3 and Chapter 4 present the results of the qualitative case studies and the statistical verification, respectively. In Chapter 5 some central conclusions are drawn, and a look is taken at the possible directions of future work on surface analysis. References are given in Chapter 6.

Detailed results of the statistical verification are compiled in an Appendix.

A list of abbreviations and acronyms used throughout the report is given below. Section 1.5 contains a map of geographical names referred to in the text.

1.4 Abbreviations

AMIS	AgroMeteorological Information System, see Chapter 2.1.
HIRLAM-D	High Resolution Limited Area Model (5 km version), see Chapter 2.2.
OI-analysis	HIRLAM optimum-interpolation surface analysis, see Chapter 2.3.

Month no. 1	April 21-May 20 1999
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Month no. 2	May 21-June 20 1999
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Month no. 3 June 21-July 20 1999
Month no. 4 July 21-August 19 1999

ME Mean Error, i.e. the sum of the difference between the analysed values and the observations, divided by the number of observations.

MAE Mean Absolute Error, i.e. the sum of the absolute difference between the analysed values and the observations, divided by the number of observations.

RMSE Root Mean Square Error, i.e. square root of the mean squared error.

HR 1 Hit Rate, i.e. the relative number of analysed value that are within +/- 1 degrees Celsius of the observed temperature.

HR 2 Hit Rate, i.e. the relative number of analysed value that are within +/- 2 degrees Celsius of the observed temperature.

HR 5 Hit Rate, i.e. the relative number of analysed value that are within +/- 5% of the observed relative humidity.

HR 10 Hit Rate, i.e. the relative number of analysed value that are within +/- 10% of the observed relative humidity.

All Hit Rates are given in percent hits.

ME, MAE and RMSE are in degree Celsius in tables showing temperature statistics and in percent humidity in tables showing relative humidity statistics.

1.5 Map of geographical names



Figure 1.5.1 Map of geographical names

2. The Field Types

2.1 AMIS

AMIS, DMI's AgroMeteorological Information System, provides farmers and other users within the Danish agricultural community with local meteorological data on a real-time basis. All numerical data are available on a 10 by 10 kilometre grid covering Danish land area. There are 632 AMIS points, or 'squares', in all (Figure 2.1.1).

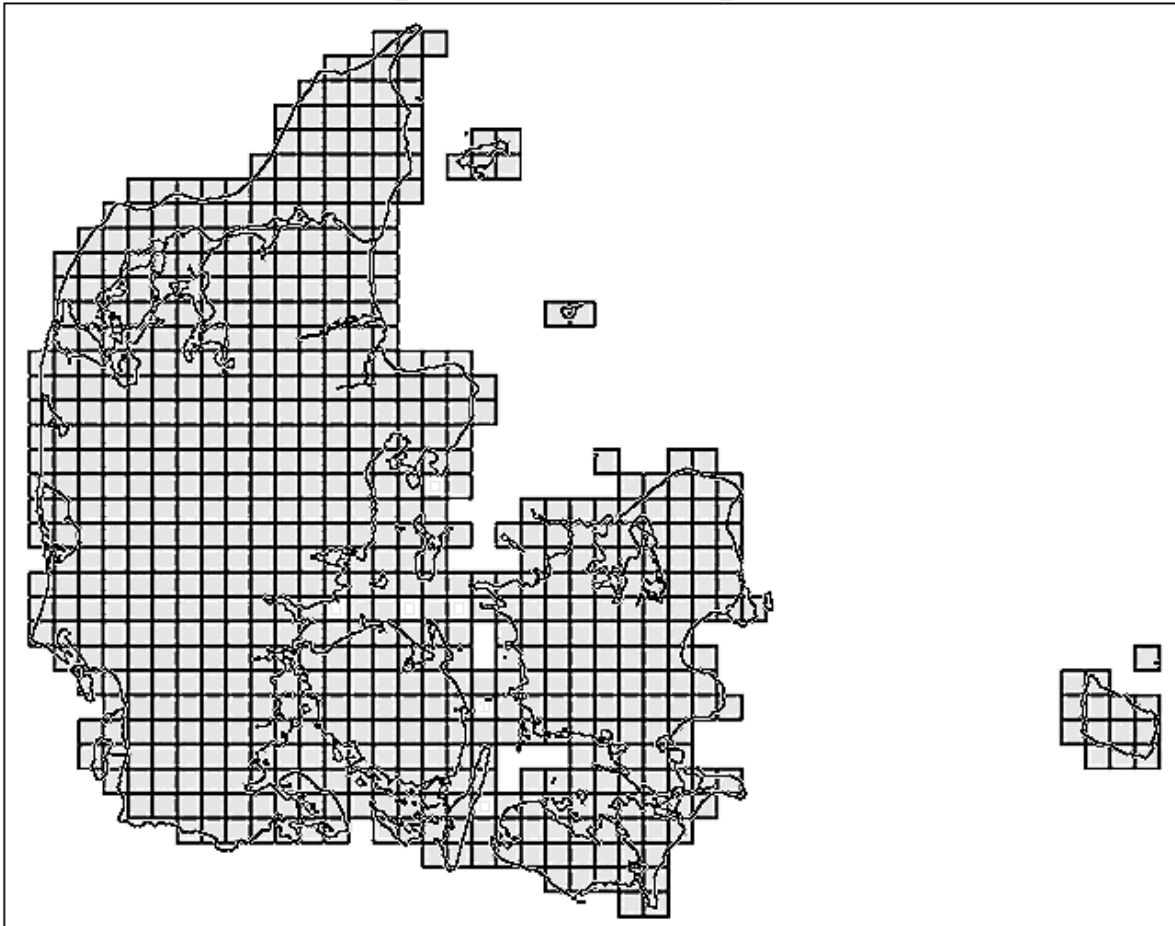


Figure 2.1.1 The AMIS grid

The AMIS observational data are computed from standard meteorological observations made at SYNOP stations in Denmark, southern Sweden and northern Germany, and at Danish automatic climate stations (potential evaporation is calculated at SYNOP stations using a dedicated model, see Christensen and Sass 1994, Christensen 1996). For each AMIS square, the value of a given parameter at a given time is obtained by interpolation of the values from stations within a predefined cutoff radius. The interpolation algorithm is simple distance weighting with weights proportional to d^r , where d is distance and r is a parameter dependent (negative) power. In the rare case of very poor data coverage, all available measured values from stations near Denmark are used. Certain stations known to have a bad

impact on the AMIS fields for one or more parameters are left out in the interpolation for these parameters.

Table 2.1 gives an overview of the observational parameters which were included in AMIS in the growing season of 1999. The approximate number of measuring stations contributing to the AMIS fields for each parameter and the interpolation power and cutoff radius are also given.

Parameter	Time	No. of stations (approx.)	Interpol. radius (km)	Interpol. power	Description
2MT	00,03,...,21 UTC	150	60	-1.7	Temperature 2 m above ground (degrees Celsius)
2MRH	00,03,...,21 UTC	150	60	-1.7	Relative humidity 2 m above ground (percent)
10MFF	00,03,...,21 UTC	150	70	-1.3	Wind speed 10 m above ground (m/s)
24HAT	06-06 UTC	113	80	-1.4	24 hours' accumulated precipitation (mm)
24HPEV	06-06 UTC	38	80	-1.4	24 hours' accumulated potential evaporation (mm)
24HGLR	06-06 UTC	19	100	-2.3	24 hours' accumulated radiation (MJ/m ²)

Table 2.1 AMIS observed parameters

2.2 The Operational HIRLAM Model

DMI's current operational forecasting system for Denmark consists of three nested models, DMI-HIRLAM-G, DMI-HIRLAM-E and DMI-HIRLAM-D, which are all versions of the HIRLAM model (see Sass 1999 for the version which was operational in spring/summer 1999). The large scale model HIRLAM-G is driven with boundary data from the global model of the European Centre for Medium-Range Weather Forecasts (ECMWF). HIRLAM-G covers a large part of the northern hemisphere with a horizontal resolution of about 50 km. It provides the boundaries to HIRLAM-E, a nested model which covers Europe and the eastern part of the North Atlantic with a resolution of about 15 km. The third nested model HIRLAM-D makes use of the HIRLAM-E forecasts at its boundaries and covers Denmark with a resolution of approximately 5 km.

HIRLAM-D is applied four times a day with boundaries from HIRLAM-E for the times 00, 06, 12 and 18 UTC. A data assimilation is carried out when the model is started, which introduces observations from within the domain of HIRLAM-D. During the forecast run, an update of the boundaries is performed using HIRLAM-E forecasts valid every hour. The forecast length is 36 hours for the forecasts started at 00 and 12 UTC. For those started at 06 and 18 UTC, the forecast length is limited to 6 hours. Among the numerous predicted parameters are fields for temperature and relative humidity at 2 m above the ground level.

As the quality of the forecast slowly decreases with growing forecast length, the most reliable forecasts are obtained within the first 12 hours of the forecast. Concerning the analysis applied in the work of this project, the respective 6 hour forecasts from the operational HIRLAM-D runs were used.

2.3 The OI-analysis Scheme

The analysis scheme for the 2 m temperature and relative humidity is part of the international HIRLAM reference system. It is based on the Optimum Interpolation method (OI) and takes into account the land-sea contrast when correlating the observations as well as the distance of the observations to the analysis point (Navascues 1997). It is not to be confused with the operational 3-D analysis scheme, which also uses OI.

The starting point for the analysis is a first guess field, which in this case is given by the HIRLAM-D forecast. It contains a prescribed uncertainty in the temperature and humidity data, which is given in terms of the standard deviation. The second important input to the analysis are observations of temperature and humidity from the domain that is covered by HIRLAM-D. There is also an uncertainty connected to the measurements. The quality of each observation is tested in order to prevent that erroneous measurements influence the analysis. The OI method combines the first guess field and the observations by minimising the analysis error. This means that the resulting uncertainty of the analysis is less than both the uncertainty from the first guess and that from the observations (Daley 1991).

In order to limit the necessary computer resources, the analysis is performed in "boxes", i.e. subdomains of the HIRLAM-D domain. The domain of each box overlaps with the neighbouring boxes to assure consistency at the box boundaries (Lorenc 1981).

The analysis was applied as follows: The first guess fields for 2 m temperature and 2 m relative humidity were provided from 6 hour forecasts of the operational HIRLAM-D with a horizontal resolution of 5 km. Their uncertainty was estimated to 2 K for the temperature and 22 % for the relative humidity. The estimated uncertainties for the observations were 0.5 K and 10 % respectively. The resulting analysis was determined on a grid with the same geometry as that of the first guess field.

3. Evaluation of Cases

3.1 May 5th, 1999: Cold-air advection and Radiative Heating

The weather situation at the 5th of May 1999 was characterised by a high pressure system over Scandinavia. The anticyclone influenced also Denmark and the North Sea and lead to steady easterly winds on a large synoptical scale (Figure 3.1.1). Apart from some cirrus clouds there were only little amounts of cloudiness over Denmark this day. The temperature curve showed a significant amplitude due to the steady irradiation from the sun, but this did not result in a significant development of sea-breeze winds because of quite strong synoptic flow.

The easterly winds transported relatively cold air over Denmark. This lead to a strong temperature gradient over Denmark. If we take a look at the observations in Figure 3.1.2, we can see low temperatures of about 6 - 7 °C in the south eastern part of Zealand and on the east coast of Falster and Møn, cf the map section 1.5. At the west coast of Jutland the temperature reaches 16 °C. This gradient is represented by both AMIS and the OI-analysis (Figure 3.1.3 and Figure 3.1.4). It is also found in the HIRLAM-D forecast, where it is weaker (Figure 3.1.5). At this point it can be clearly seen how the OI-analysis improves the HIRLAM-D forecast by including actual observations.

There is no fine detail in the field from AMIS. The OI-analysis, however, shows a more detailed structure of the gradient. The cool areas over the Baltic sea and the Kattegat have an influence on the temperatures near the east coasts due to the steady easterly wind. The observations on Bornholm and Møn as well as other coastal stations (Århus Havn, Sprogø Øst and Omø) indicate this, and the OI-analysis represents the effect very well. This is mainly due to the good forecast of Hirlam-D. The temperature gradient over Bornholm is also better represented in the OI-analysis than in AMIS.

Concerning relative humidity, the general picture shows a gradient with decreasing humidity towards the west. However, it is not as clear as in the temperature field. The observations show very dry areas over Jutland for example (Figure 3.1.6). AMIS represents the low humidity quite well, whereas the OI-analysis gives higher values of humidity over Jutland (Figure 3.1.7 and Figure 3.1.8). Over Lolland, both AMIS and the OI-analysis show higher humidity than the observations. This has different reasons. In AMIS, which calculates interpolated values from the observations supplied to it, the station Abed on Lolland (55% relative humidity) is not included in the calculations. Thus AMIS has not enough information about the humidity conditions over Lolland. On the other hand, the forecast of relative humidity from the HIRLAM-D forecast for this area is better than the OI-analysis (Figure 3.1.9). The performance of the OI-analysis is rather poor in this case probably due to the same lack of measurements from Lolland and also due to the influence of analysed humidity outside of Denmark. Over Southern Sweden, for example, the HIRLAM-D forecast shows very low values of relative humidity. These are raised during the analysis and this also has an influence on other areas.

Over Bornholm, the humidity gradient is better represented in AMIS than in the OI-analysis. The gradient given in the OI-analysis is stronger than observed. The gradient from the HIRLAM-D forecast is, however, even stronger. This means that there is an improvement through the analysis, although it is not perfect.

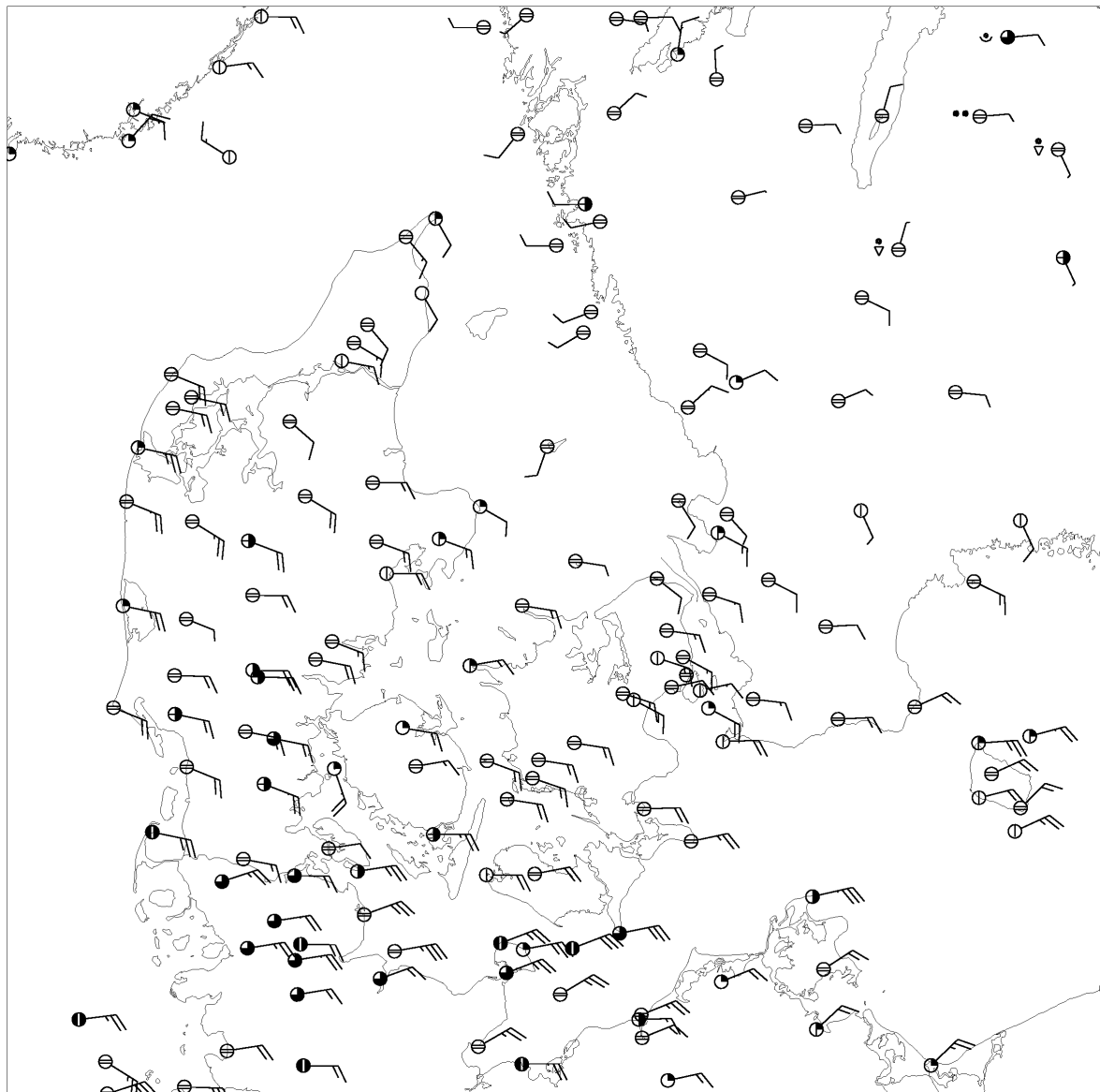


Figure 3.1.1 Observed 10 m wind and clouds, May 5th, 1999, 12 UTC

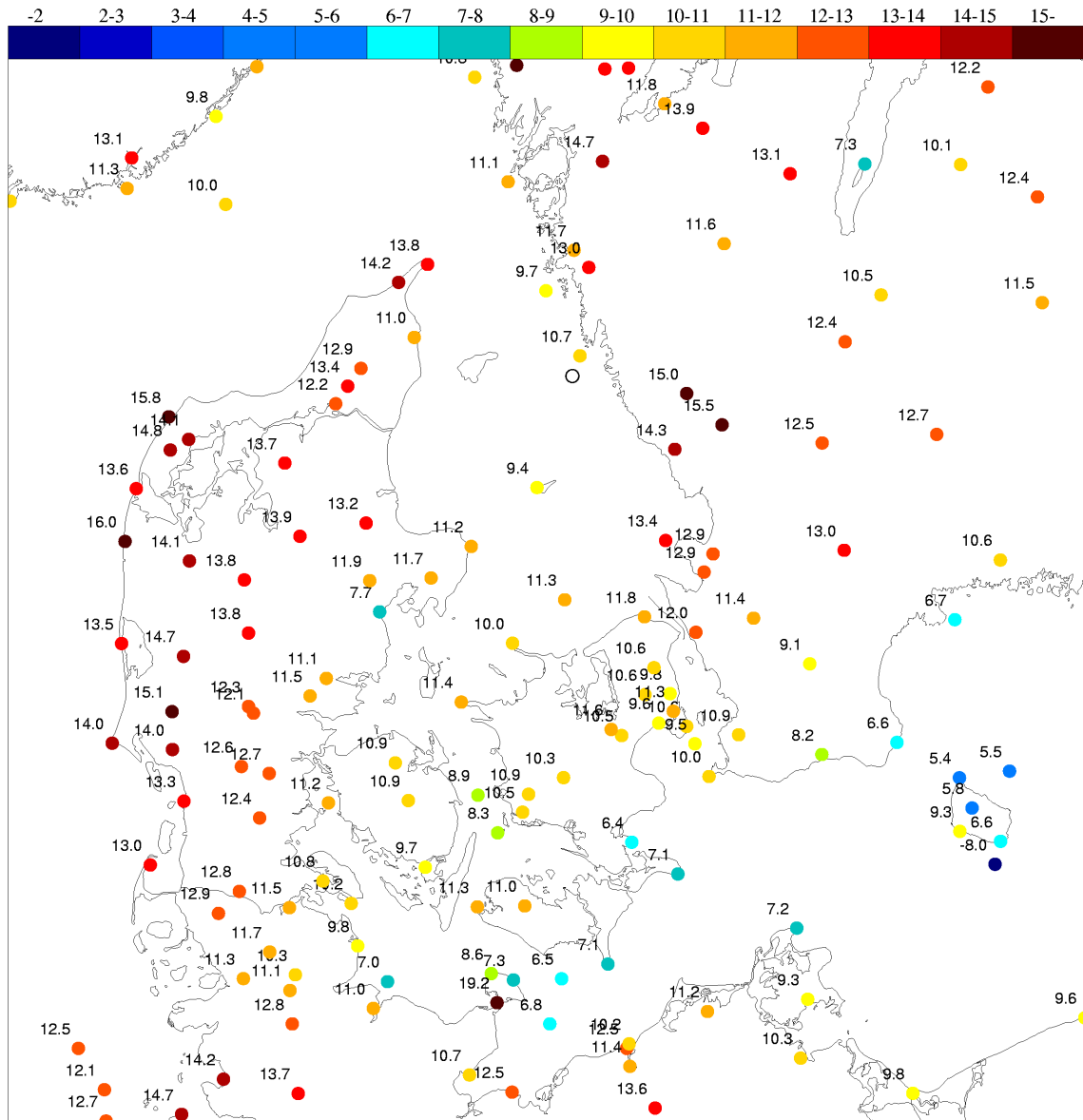


Figure 3.1.2 Observed 2 m temperature, May 5th, 1999, 12 UTC

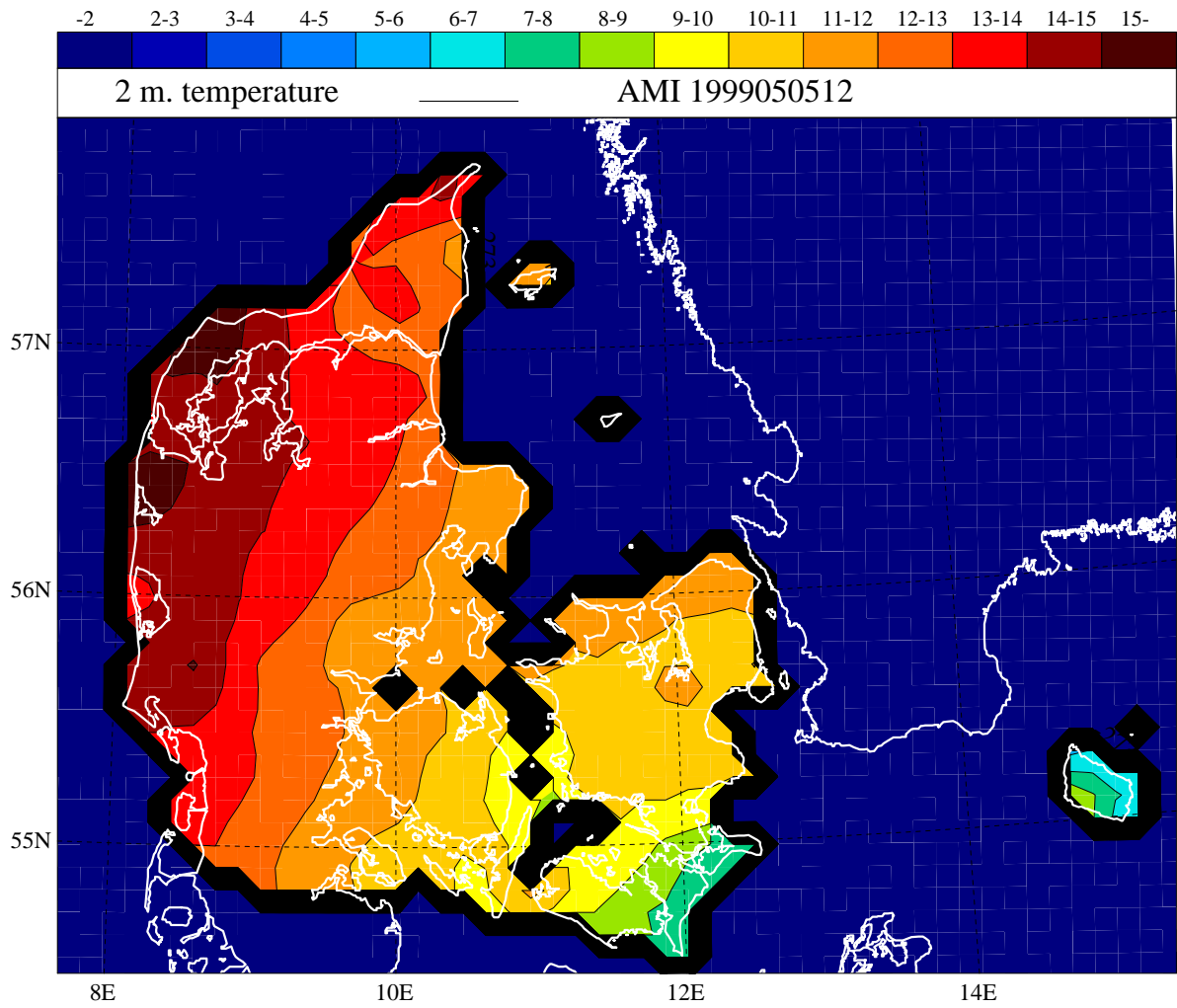


Figure 3.1.3 AMIS temperature analysis, May 5th, 1999, 12 UTC

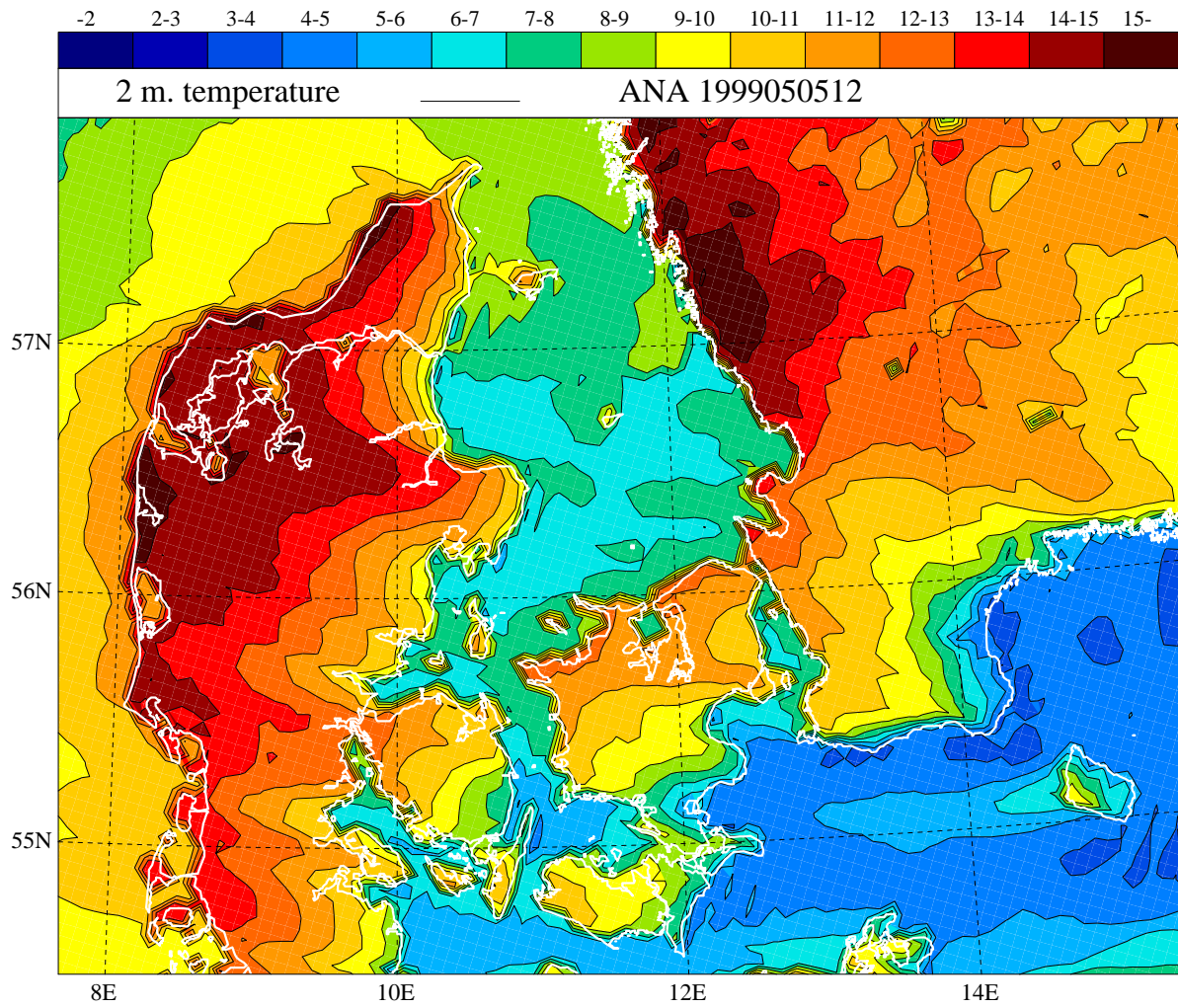


Figure 3.1.4 OI-analysis of temperature, May 5th, 1999, 12 UTC

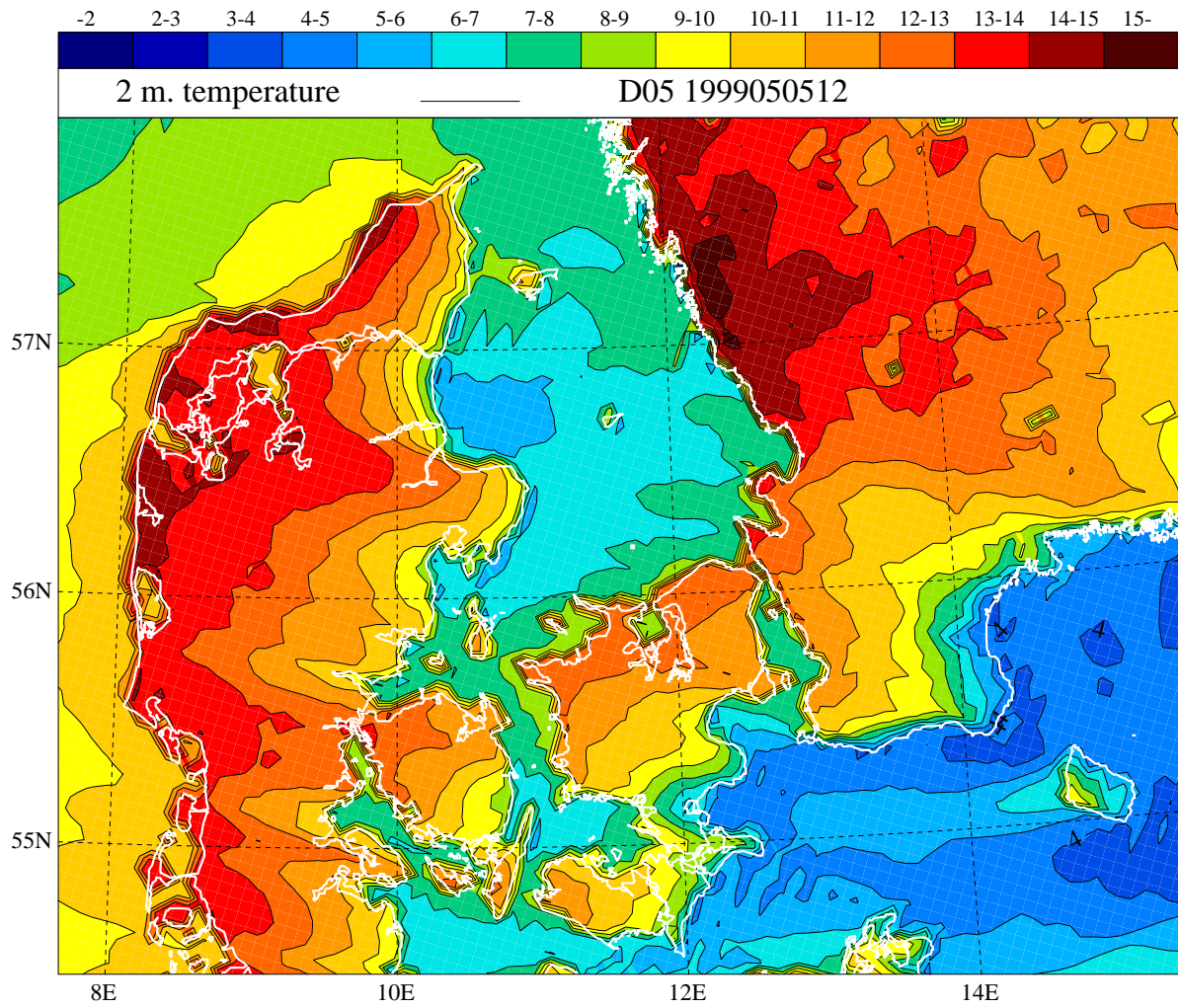


Figure 3.1.5 HIRLAM-D temperature forecast, May 5th, 1999, UTC

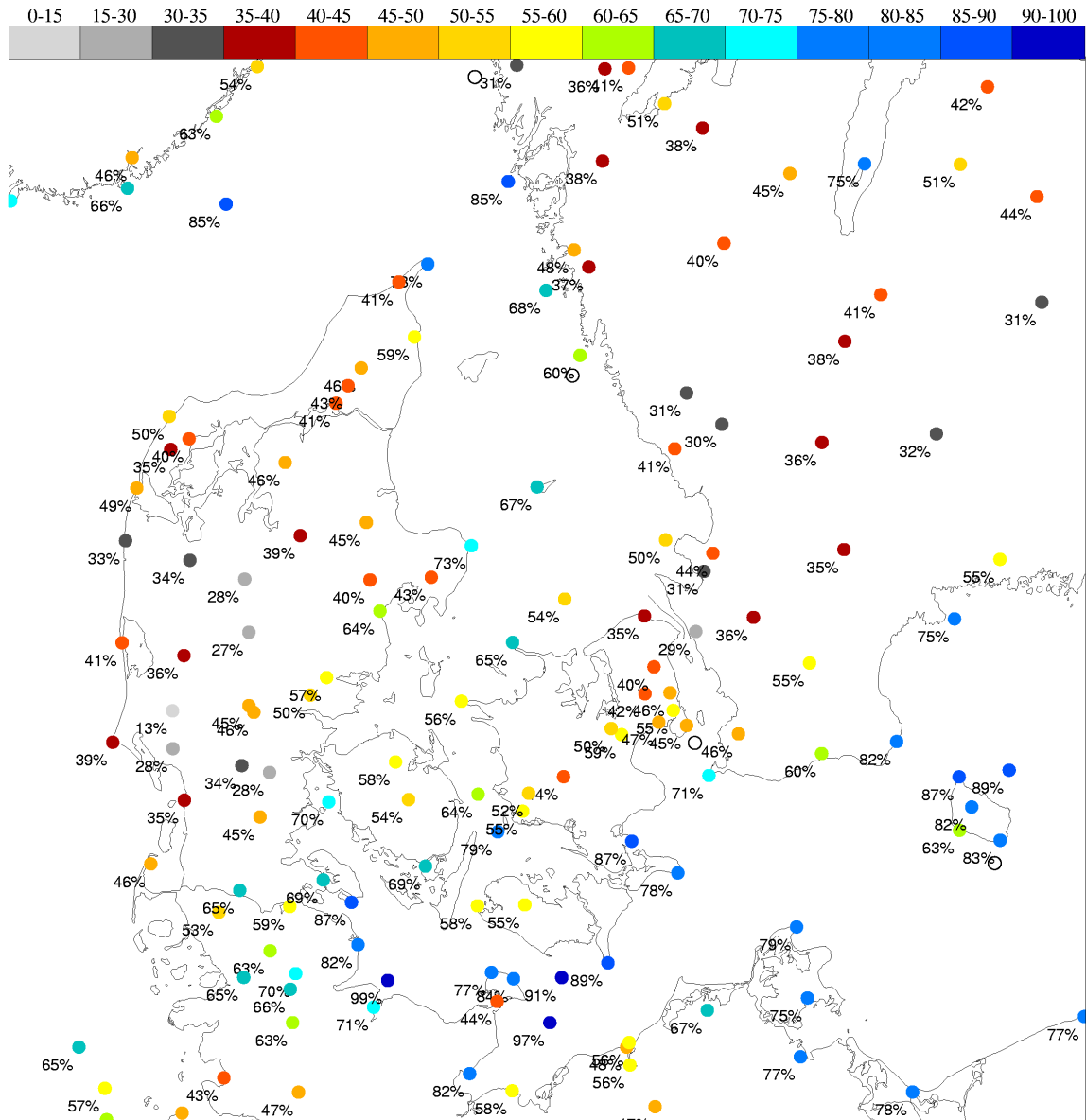


Figure 3.1.6 Observed 2 m relative humidity, May 5th, 1999, UTC

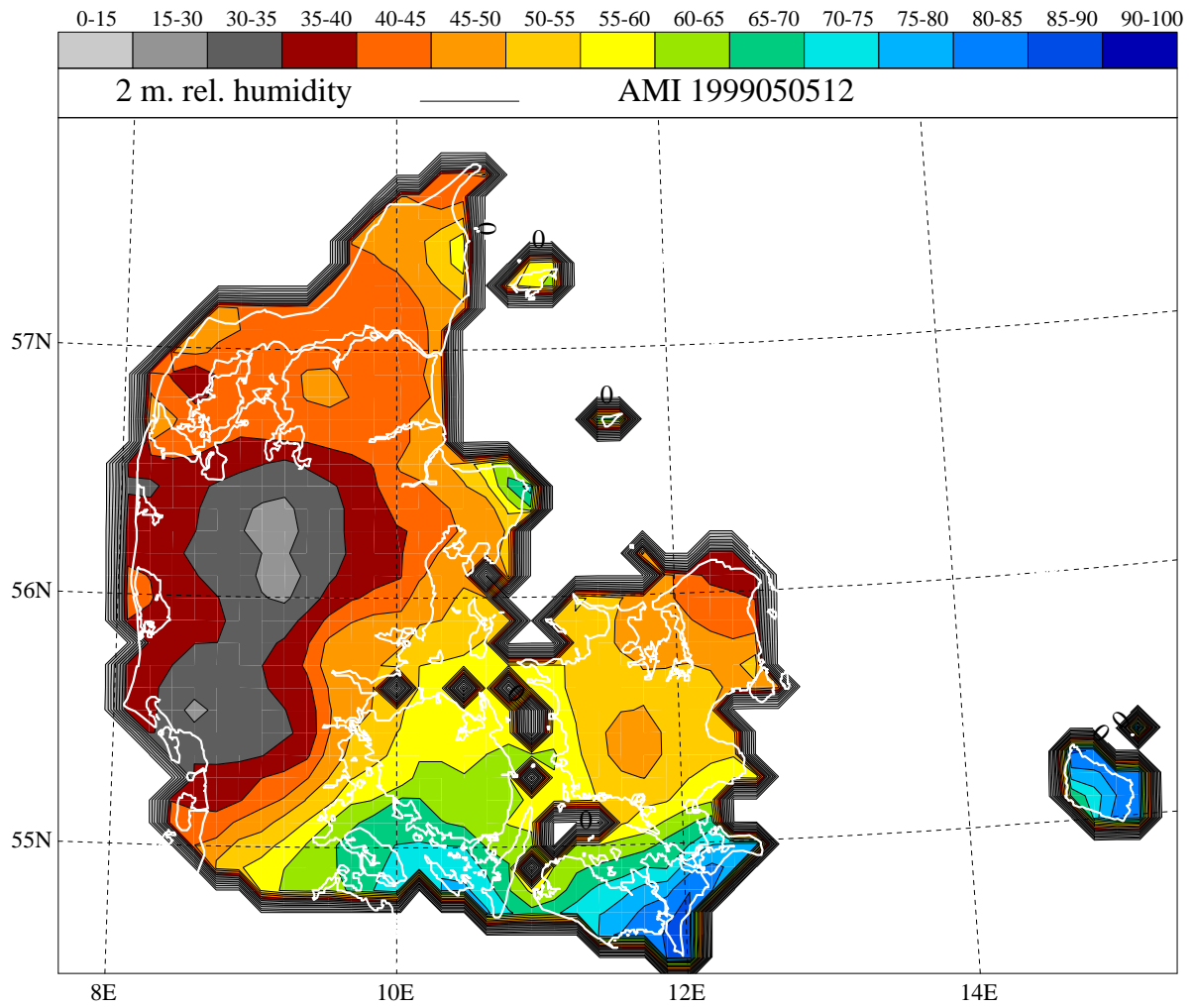


Figure 3.1.7 AMIS relative humidity analysis, May 5th, 1999, UTC

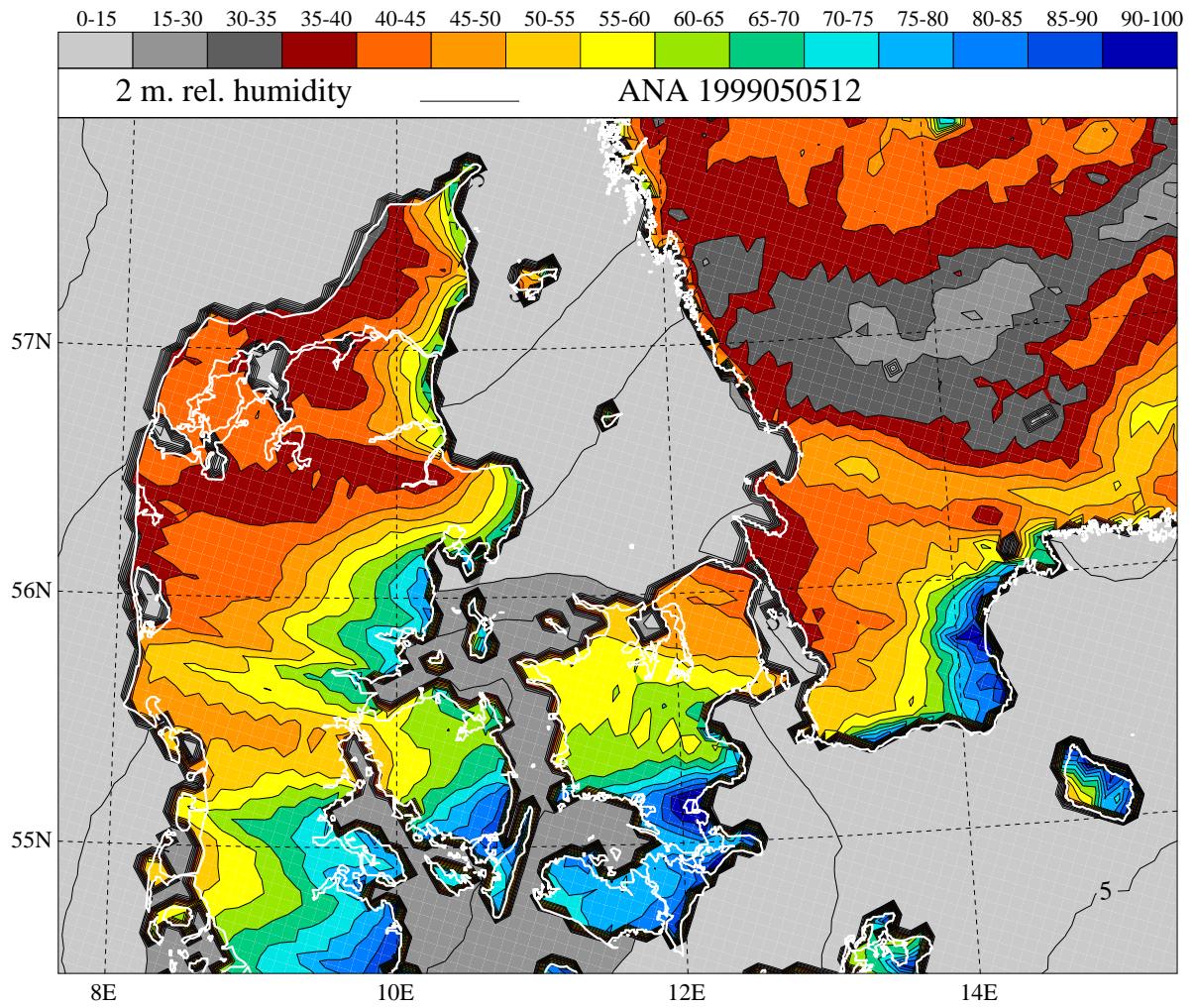


Figure 3.1.8 OI-analysis of relative humidity, May 5th, 1999, UTC

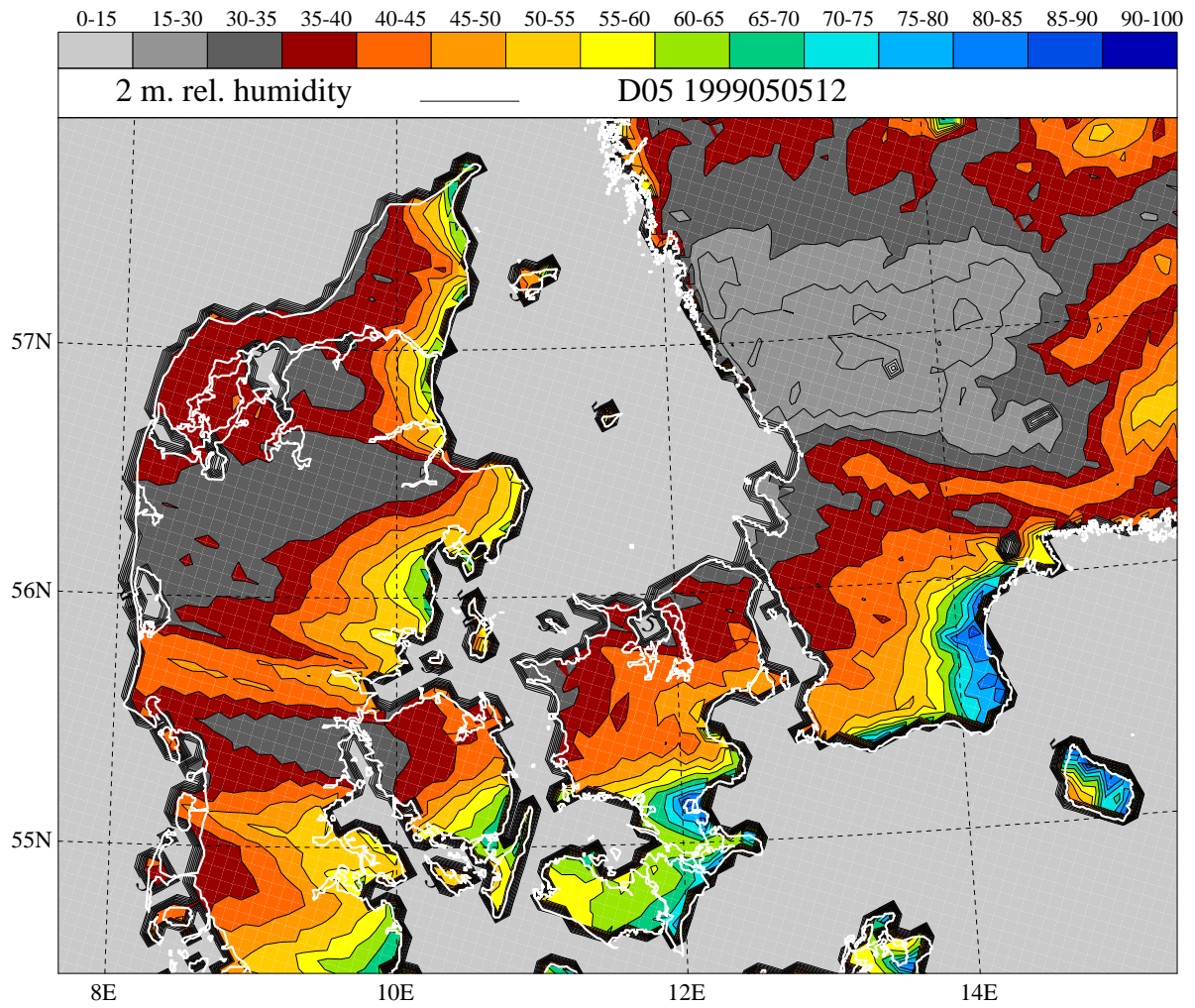


Figure 3.1.9 HIRLAM-D forecast of relative humidity, May 5th, 1999, UTC

3.2 June 17th, 1999: A Cold Front

The synoptic situation of this day is determined by a cold trough located over the North Sea at 12 UTC. It carried cold air eastwards, especially at the lower levels of the atmosphere. During the day-time, a cold front passed over Denmark. This changed the temperature and humidity conditions through the day. The cold front reached the north western part of Jutland at approximately 10:30 UTC and passed across the country during the following hours. At 15 UTC it was located over Funen and it reached the Sound at approximately 18 UTC.

The position of the cold front at 12 UTC is shown in Figure 3.2.1. Figure 3.2.2 and Figure 3.2.3 show the observations of 2 m temperature and relative humidity respectively. The air mass behind the front is approximately 5 °C colder and relative humidity is about 20% higher than before the front. The OI-analysis locates the front along the line Esbjerg-Ålborg (Figure 3.2.4). This position is mainly prescribed by the HIRLAM-D forecast (Figure 3.2.5). Compared with the actual frontal position, the tilt of the frontal line appears a little steeper than the actual tilt in the map of the HIRLAM-D forecast and thus also in the OI-analysis. In AMIS, the course of the frontal line is shifted eastwards in Northern Jutland, so that even Læsø seems to be passed by the front already at 12 UTC (Figure 3.2.6). Contrary to the OI-analysis, AMIS shows a more gentle tilt of the frontal line than the actual one. The frontal position in the OI-analysis is determined by the forecast, whereas AMIS uses the available observations, and as there are no observations available at the coast north of Djursland for 12 UTC, AMIS just interpolates between the existing surrounding observations, thus getting a wrong frontal position.

Concerning the temperature gradient within the frontal region, the one given by the HIRLAM-D forecast appears too strong, which seems to be due to an overestimation of the temperature over land. This is weakened a little in the analysis. AMIS shows a weaker gradient seeming to be more realistic. The same applies to the gradient of relative humidity. Over Lolland and Funen, AMIS shows lower temperatures than observed. This is due to the fact that three stations used for verification do not go into the calculations of AMIS. The coincidence between the OI-analysis and the actual temperatures over Lolland is very good. There is one erroneous relative humidity observation: One station (Firhøje) in West Jutland shows 34%, whereas all surrounding stations measure much higher values. As this is not taken into account in AMIS, the erroneous measurement appears as a dry spot over West Jutland, which seems rather unrealistic (Figure 3.2.7). The erroneous observation was not used in the OI-analysis, because the analysis includes a check for observation errors (Figure 3.2.8).

The relative humidity over Southwest Zealand is overestimated by the OI-analysis, because there is a strong SW-NE gradient already in the HIRLAM-D forecast, which is not that strong in the observations. The HIRLAM-D forecast gives a good estimation for humidity over Lolland (Figure 3.2.9). This is, like in the case from the 5th of May, deteriorated in the analysis because of too strong influences from other regions like for example South Sweden. AMIS does not show the dry area over Lolland, because one station here (Abed) was not used in the calculation of AMIS.

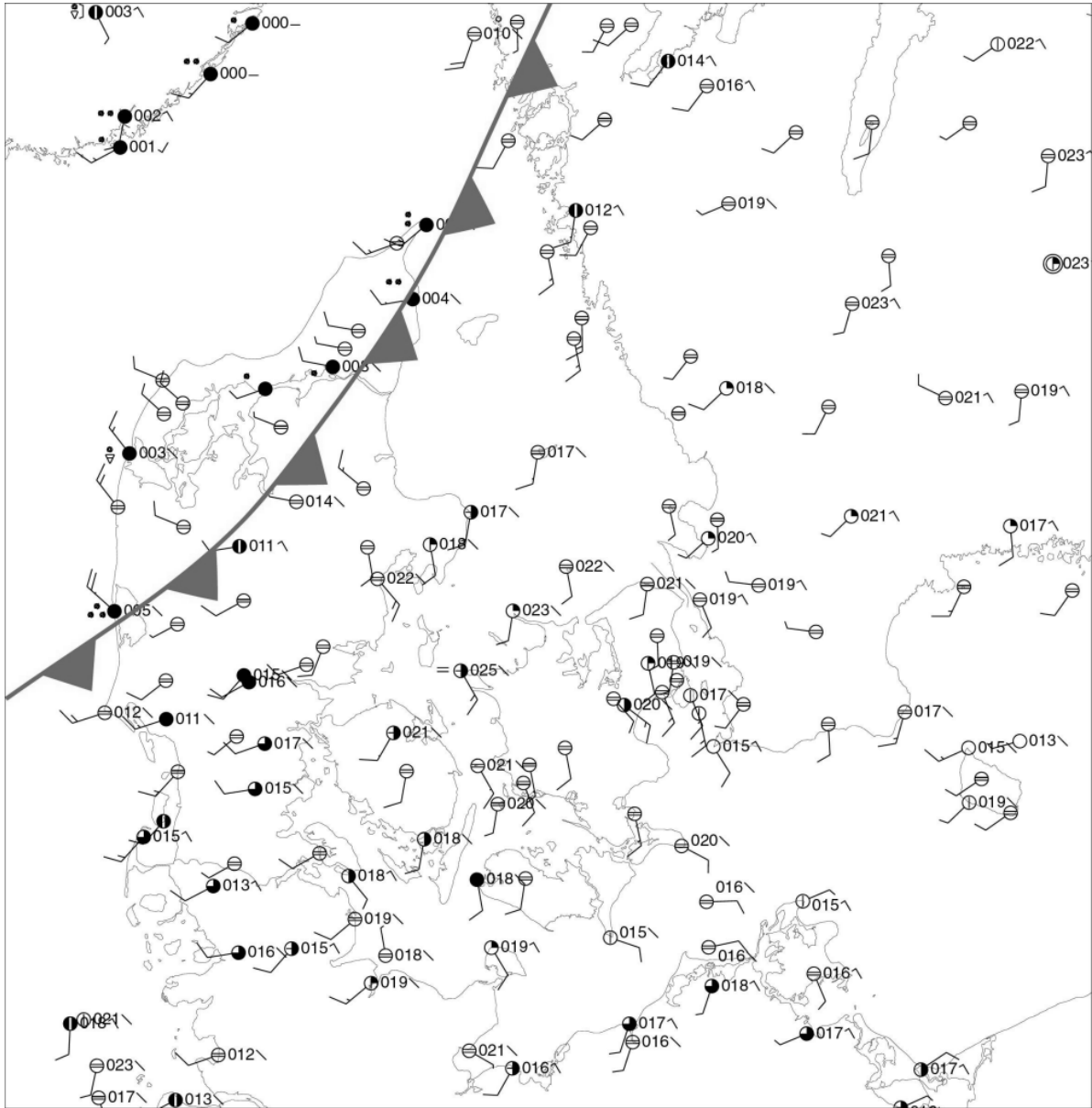


Figure 3.2.1 Observed wind, clouds, pressure tendency and weather, June 17th, 1999, 12 UTC. Approximate position of the cold front is indicated.

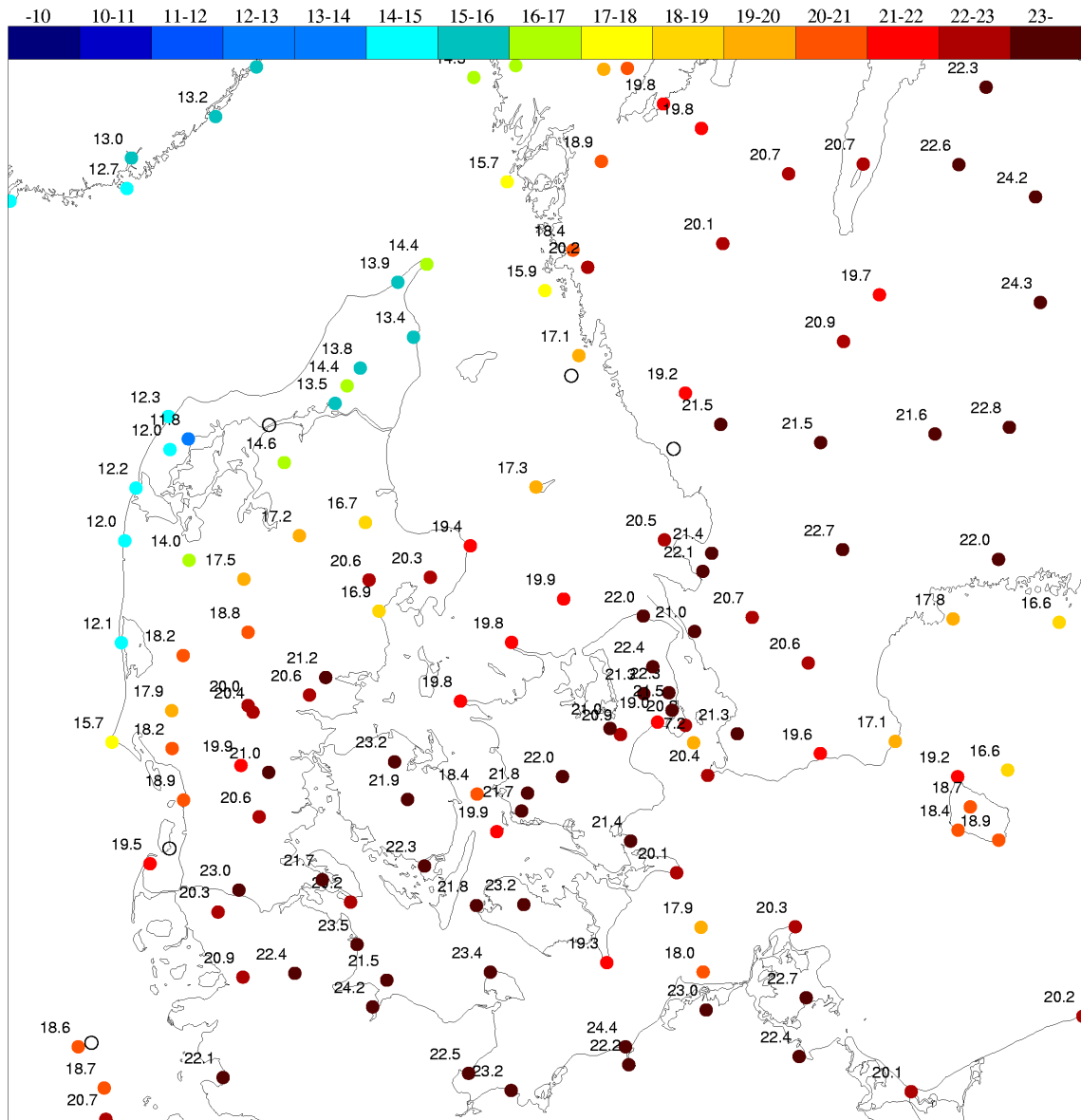


Figure 3.2.2 Observed 2 m temperature, June 17th, 1999, 12 UTC

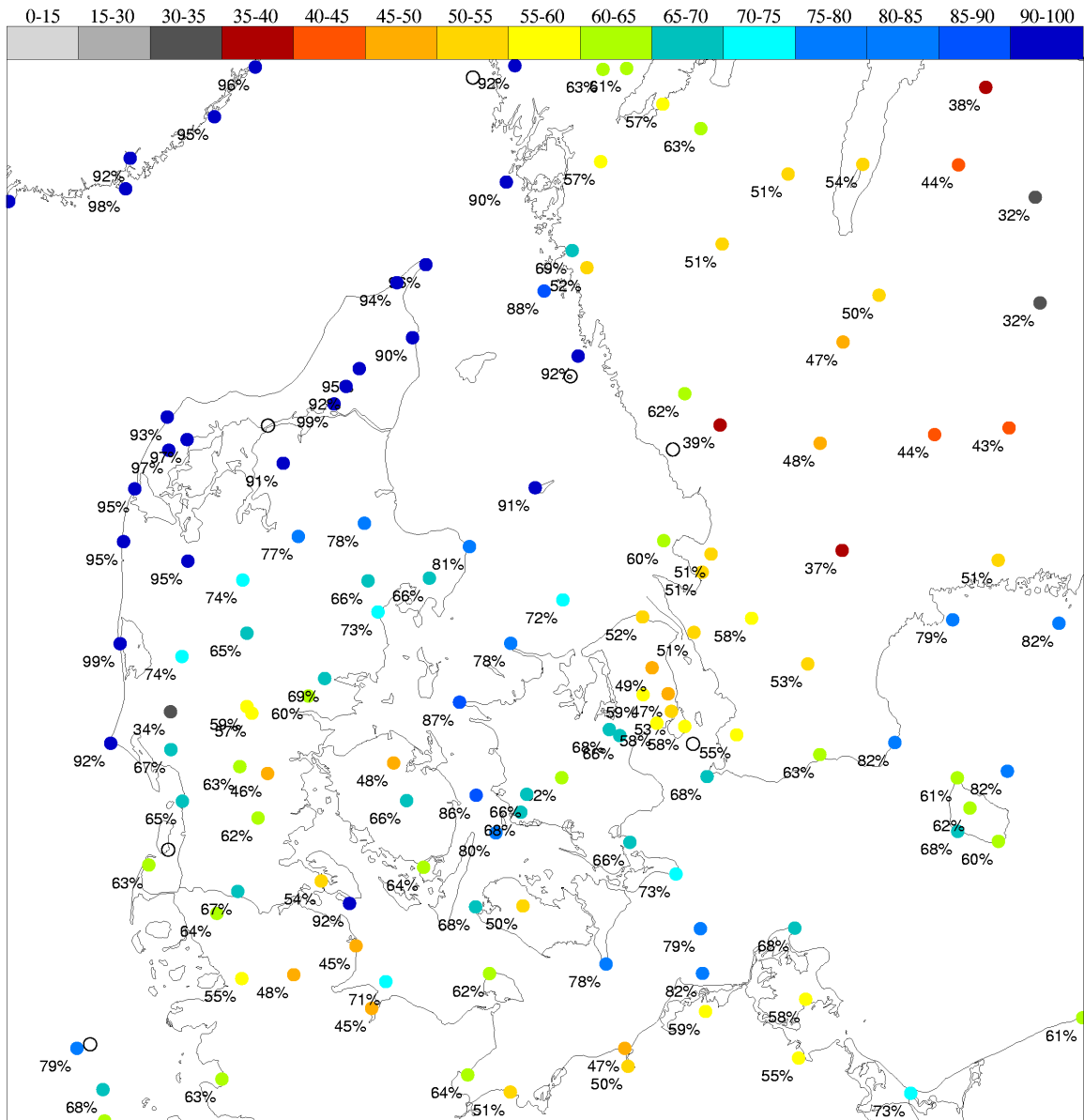


Figure 3.2.3 Observed 2 m relative humidity, June 17th,1999, 12 UTC

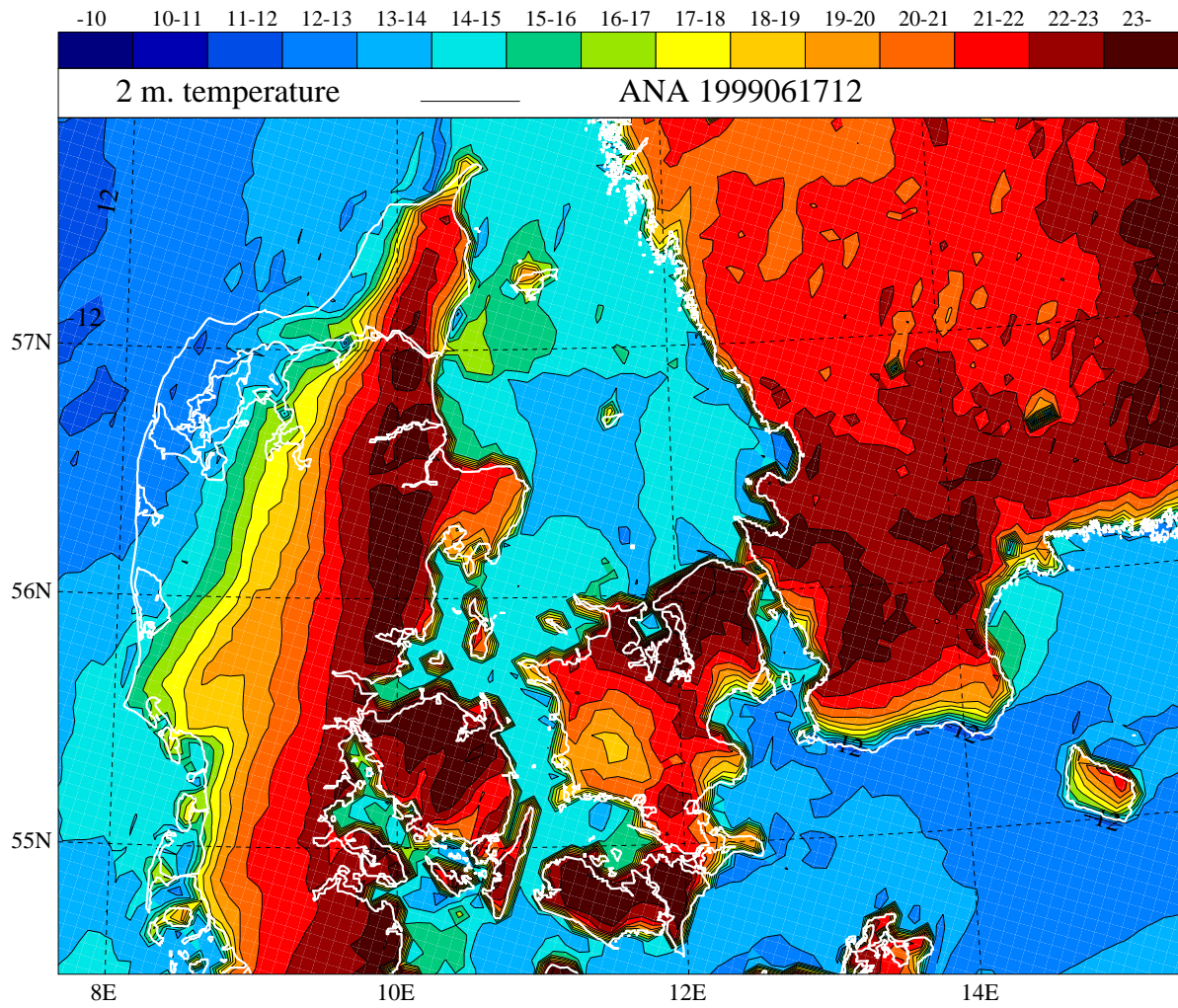


Figure 3.2.4 OI-analysis of temperature, 17th, 1999, 12 UTC

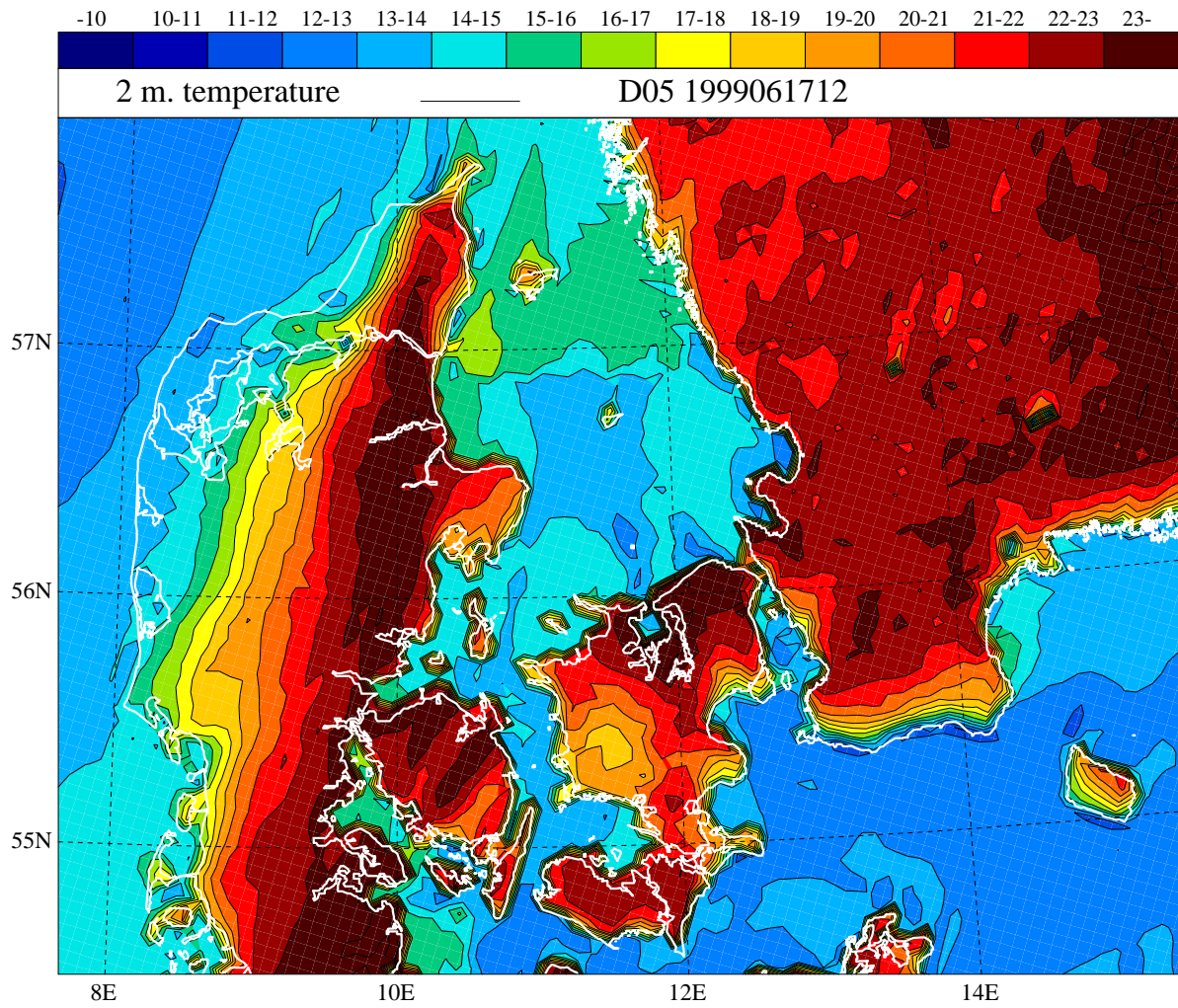


Figure 3.2.5 HIRLAM-D forecast of temperature, June 17th, 1999, 12 UTC

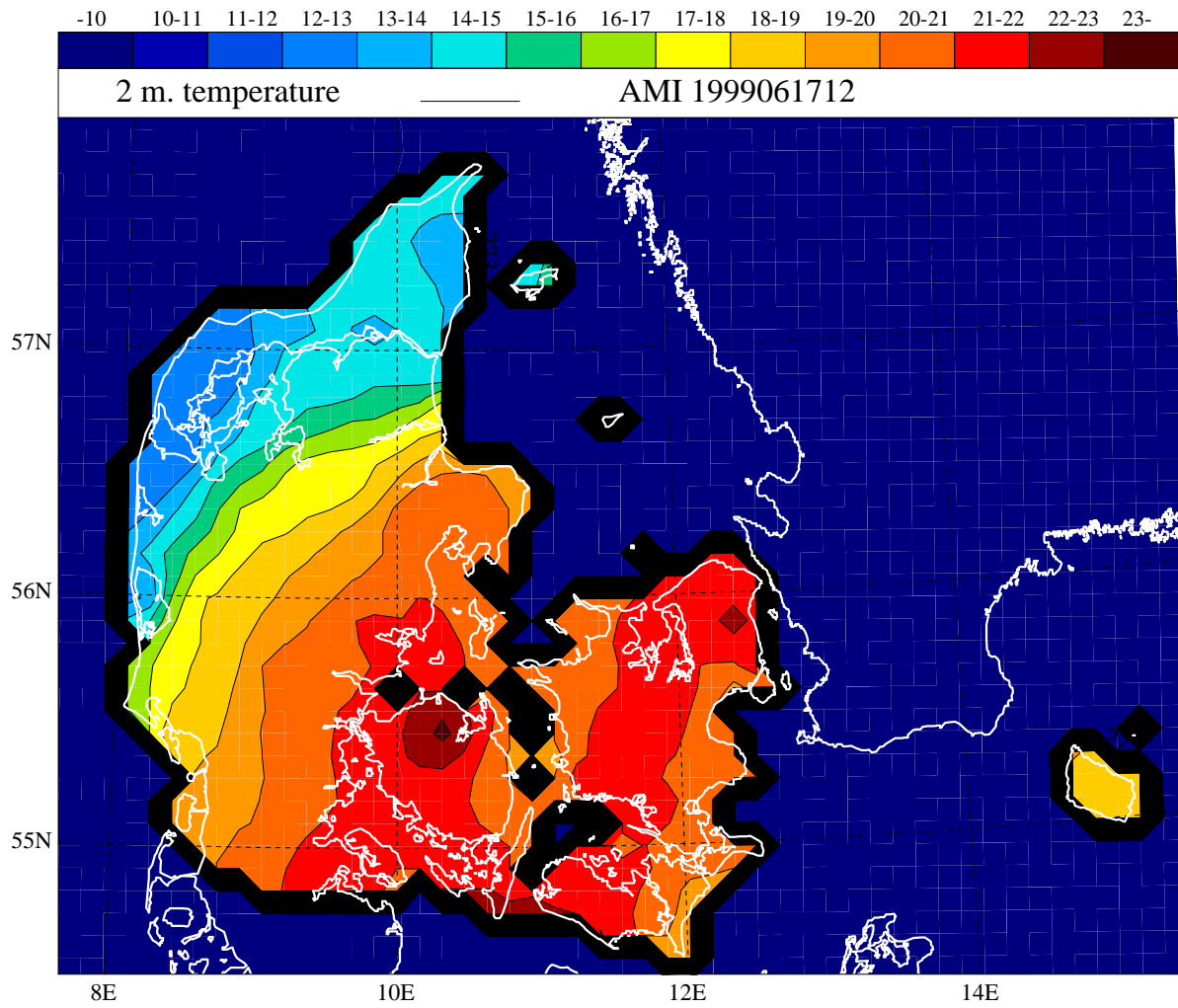


Figure 3.2.6 AMIS temperature analysis, June 17th, 1999, 12 UTC

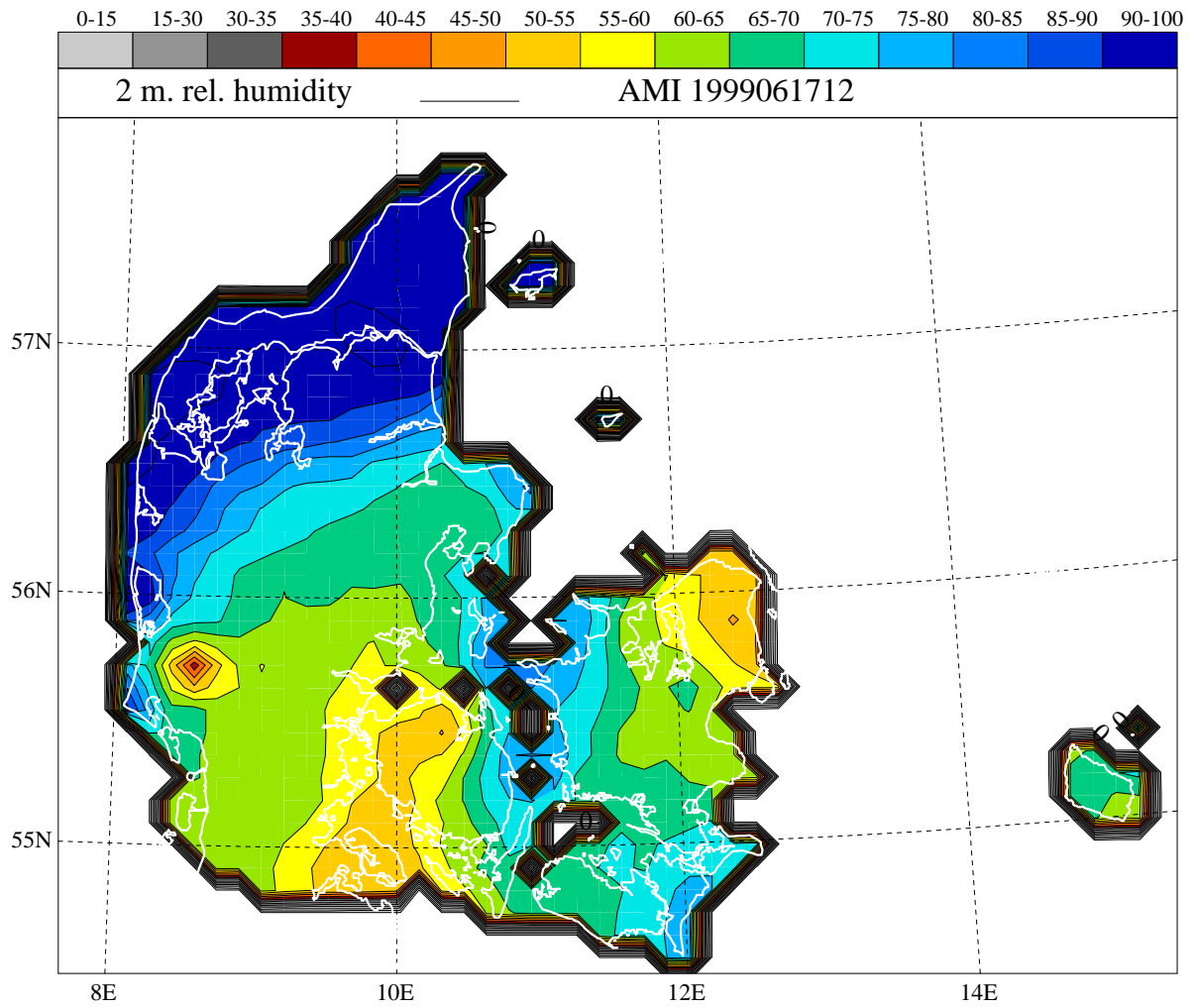


Figure 3.2.7 AMIS analysis of relative humidity, June 17th, 1999, 12 UTC

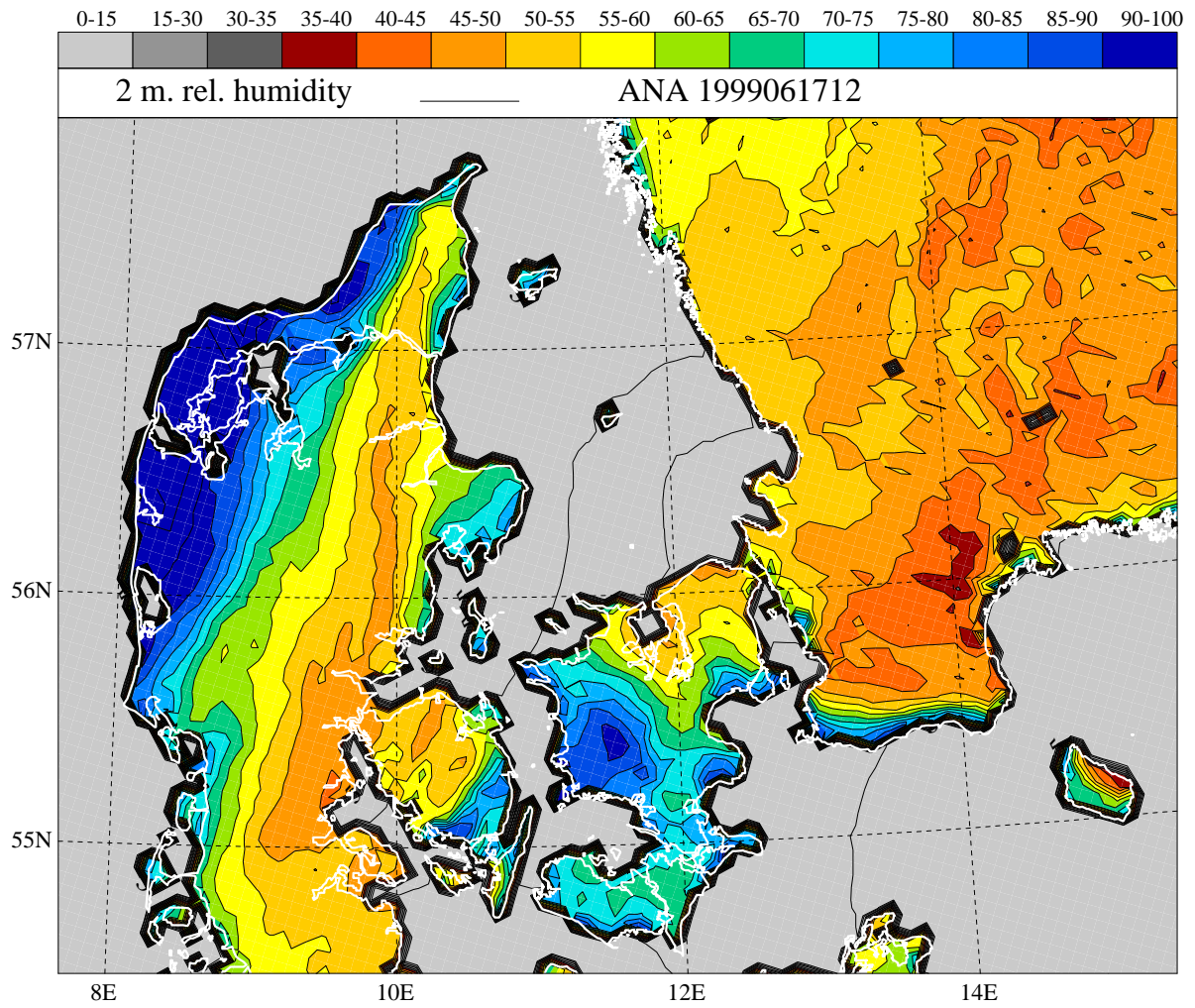


Figure 3.2.8 OI-analysis of relative humidity, June 17th, 1999, 12 UTC

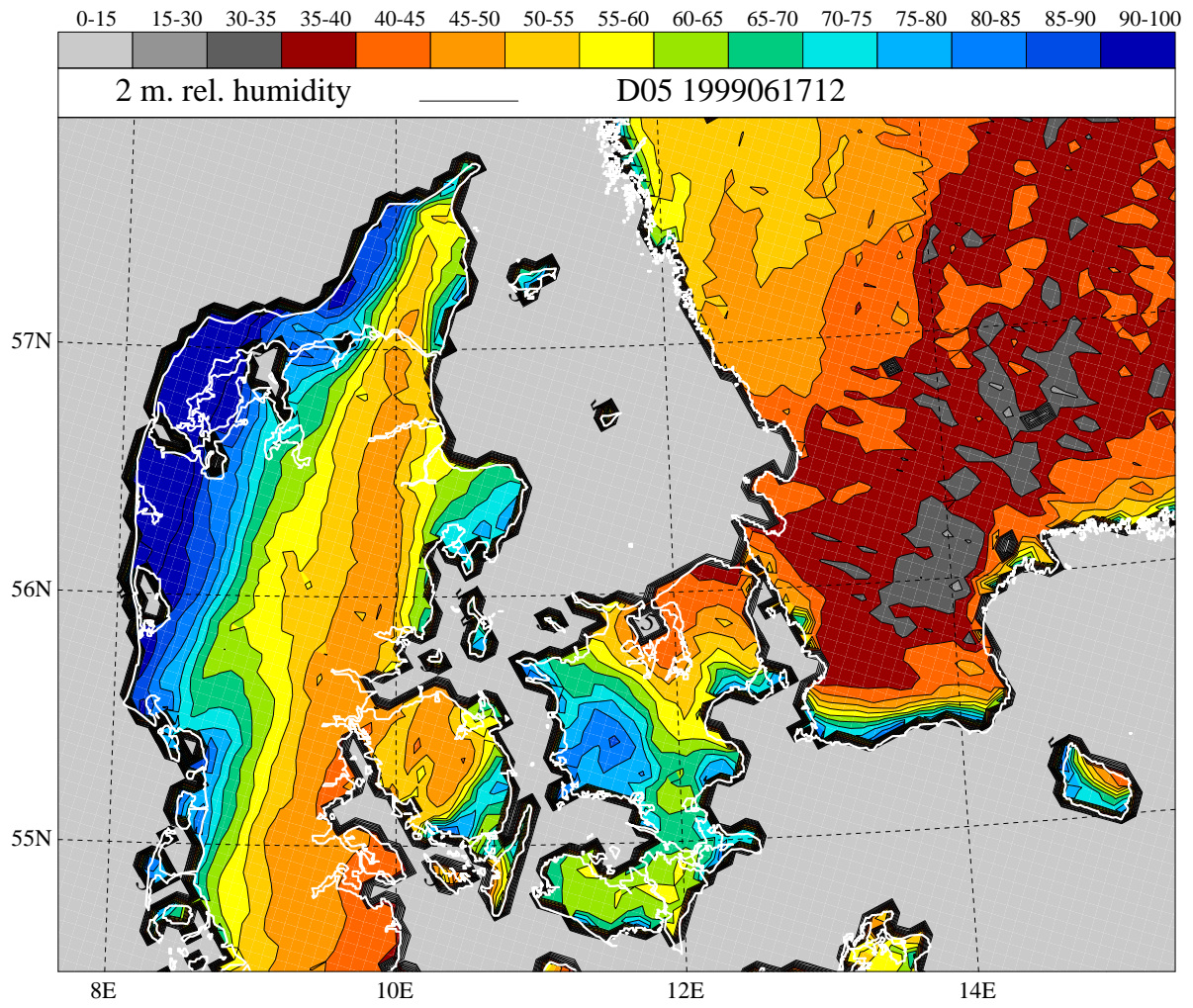


Figure 3.2.9 HIRLAM-D forecast of relative humidity, June 17th, 1999, 12 UTC

3.3 July 28th, 1999: Weak Flow and strong Radiative Cooling

The weather situation was characterised by a large high pressure system that was located over the British Isles. The pressure gradient over Denmark was weak and there was hardly any large scale flow. There was clear sky during the night between 27th and 28th of July (Figure 3.3.1). So, radiative emission was strong, leading to a large amplitude in the diurnal course of temperature. The distinct radiative conditions thermally induced land-sea-breeze circulations at the coastlines of Denmark. They dominated the wind field over Denmark at this time. This had an influence on the temperature and humidity fields near the coast. As the night during this season is rather short and sunrise already occurs at about 03 UTC, the fields at 00 UTC were taken in order to compare the conditions at night time.

As can be seen in the temperature observations, there was a distinct difference between temperature over sea and over land. Relatively high temperatures of 12 to 15 °C occur at the coastal stations, whereas the land stations show temperatures below 10 °C (Figure 3.3.2). This temperature gradient is well represented in the OI-analysis, where it originates in the HIRLAM-D forecast (Figure 3.3.3 and Figure 3.3.4). However, temperatures over land are represented higher in the OI-analysis than observed. It seems that there is too little structure in the temperature field of the OI-analysis over land this time (Figure 3.3.3). AMIS represents temperature over Jutland and Zealand quite well, but the temperature over Lolland does not seem realistic (Figure 3.3.5). This deviation is due to the lack of observations from inner Lolland. The same effect occurs over Falster, Læsø and to some extent over Funen. The field over Bornholm is represented very well in the OI-analysis, whereas AMIS cannot cope with the strong temperature gradient at the coast.

The difference in temperature between the OI-analysis and the observations shall be discussed a little further. It seems that in this case the difference between the forecast field and the observations is so strong that the analysis has difficulties in calculating a better solution. The error in the forecast fields changes in space and time. In the analysis, however, it is treated as a constant, because it can hardly be determined. Thus, there may occur cases like this one where the error is underestimated, leading to poor analysis quality over some regions.

The relative humidity during the night between the 27th and 28th of July is determined by high values of over 90% (Figure 3.3.6). As there is no significant spatial structure, the representation in AMIS is very good (Figure 3.3.7). But one must be careful on islands where there are no observations, like Læsø. AMIS is not reliable there. Contrary to the observations, the HIRLAM-D forecast and thus also the OI-analysis show a structure in the humidity field (Figure 3.3.8 and Figure 3.3.9). It is difficult to say something about the quality of these structures, but there seems to be a slight negative bias in the HIRLAM-D forecast. This bias is larger in the OI-analysis. The analysis of relative humidity does not really seem to work well in this case.

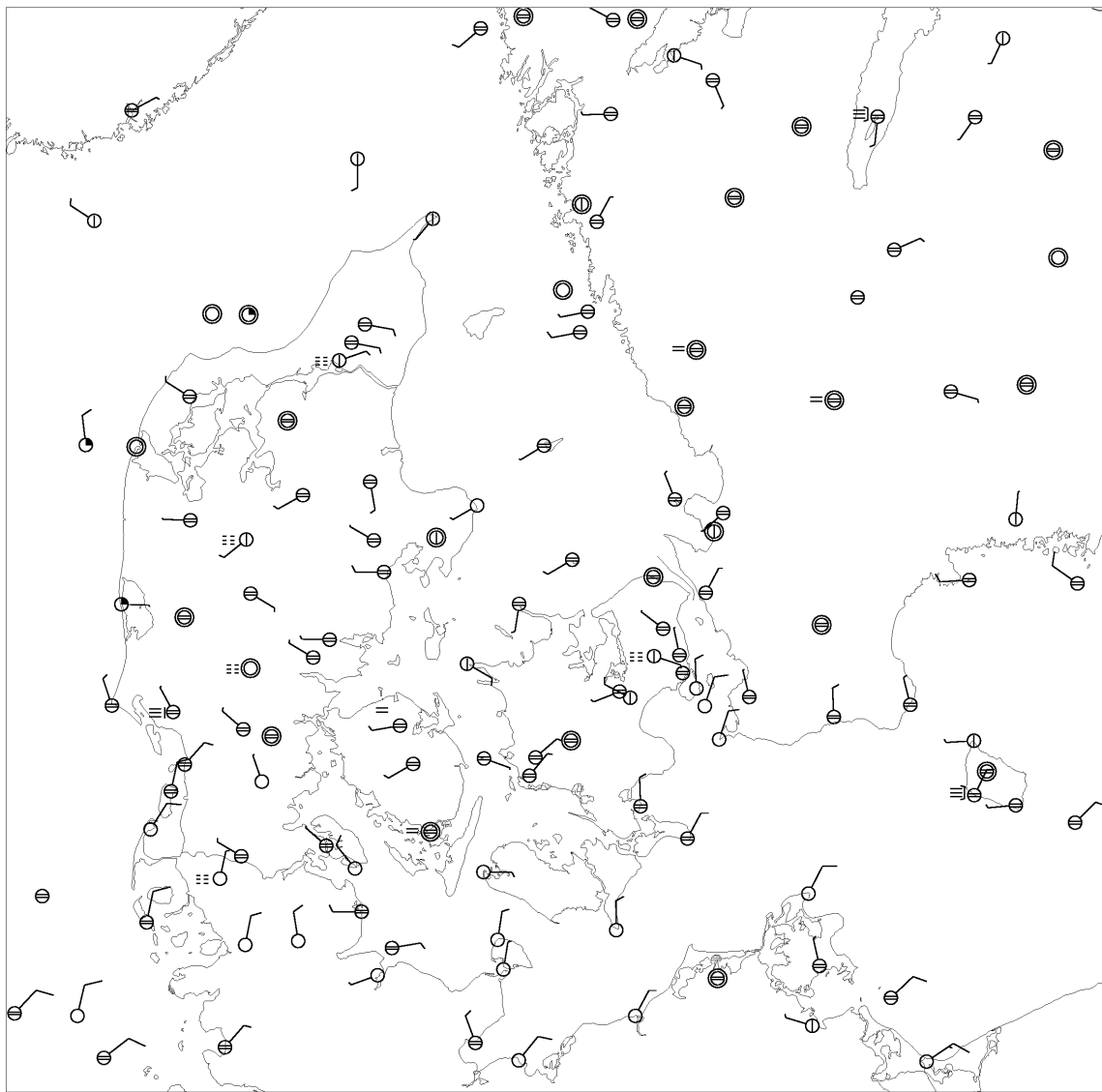


Figure 3.3.1 Observed wind, weather and cloudiness, July 28th, 1999, 00 UTC

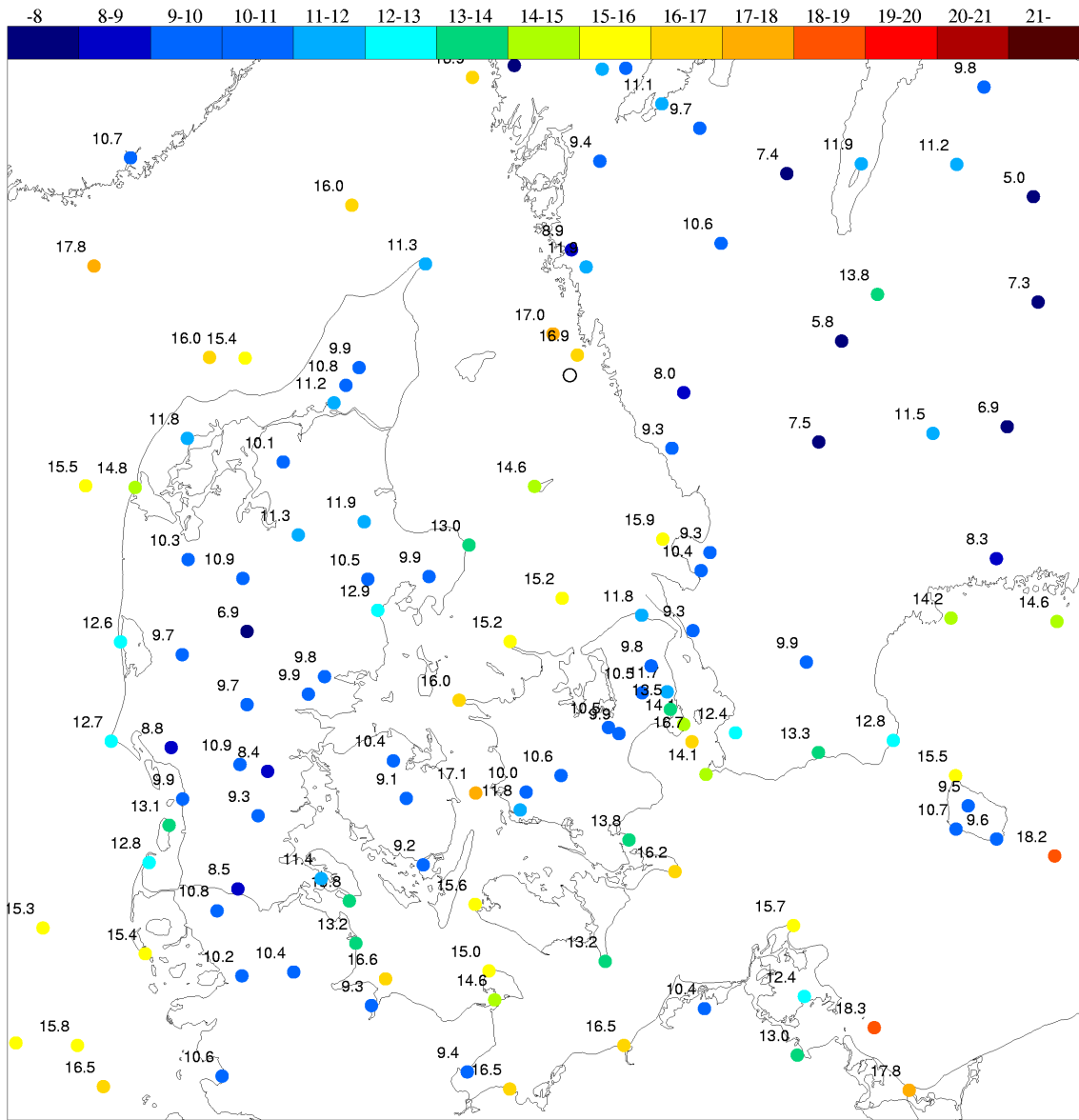


Figure 3.3.2 Observed 2 m temperature, July 28th, 1999, 00 UTC

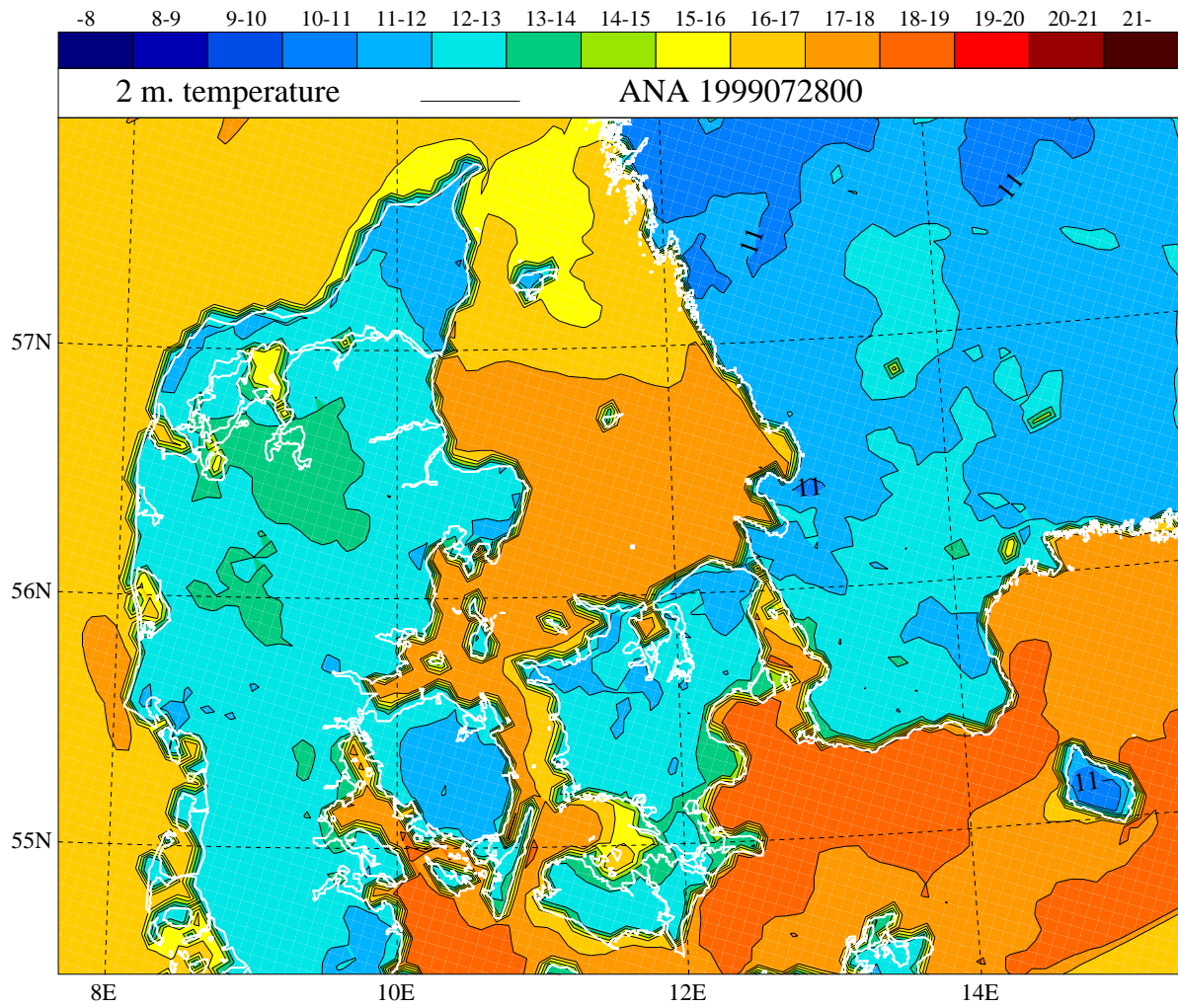


Figure 3.3.3 OI-analysis of temperature, July 28th, 1999. 00 UTC

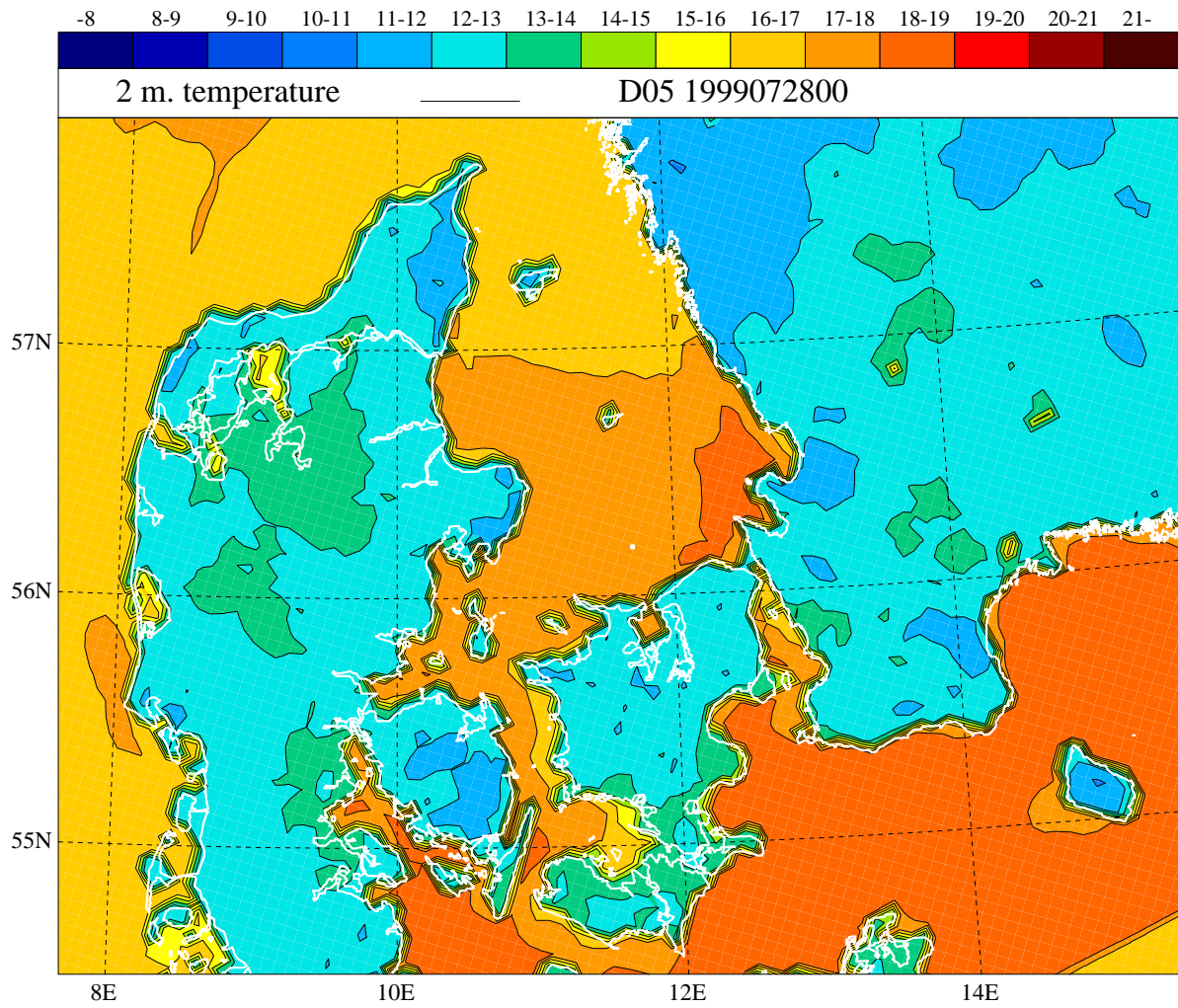


Figure 3.3.4 HIRLAM-D forecast of temperature, July 28th, 1999, 00 UTC

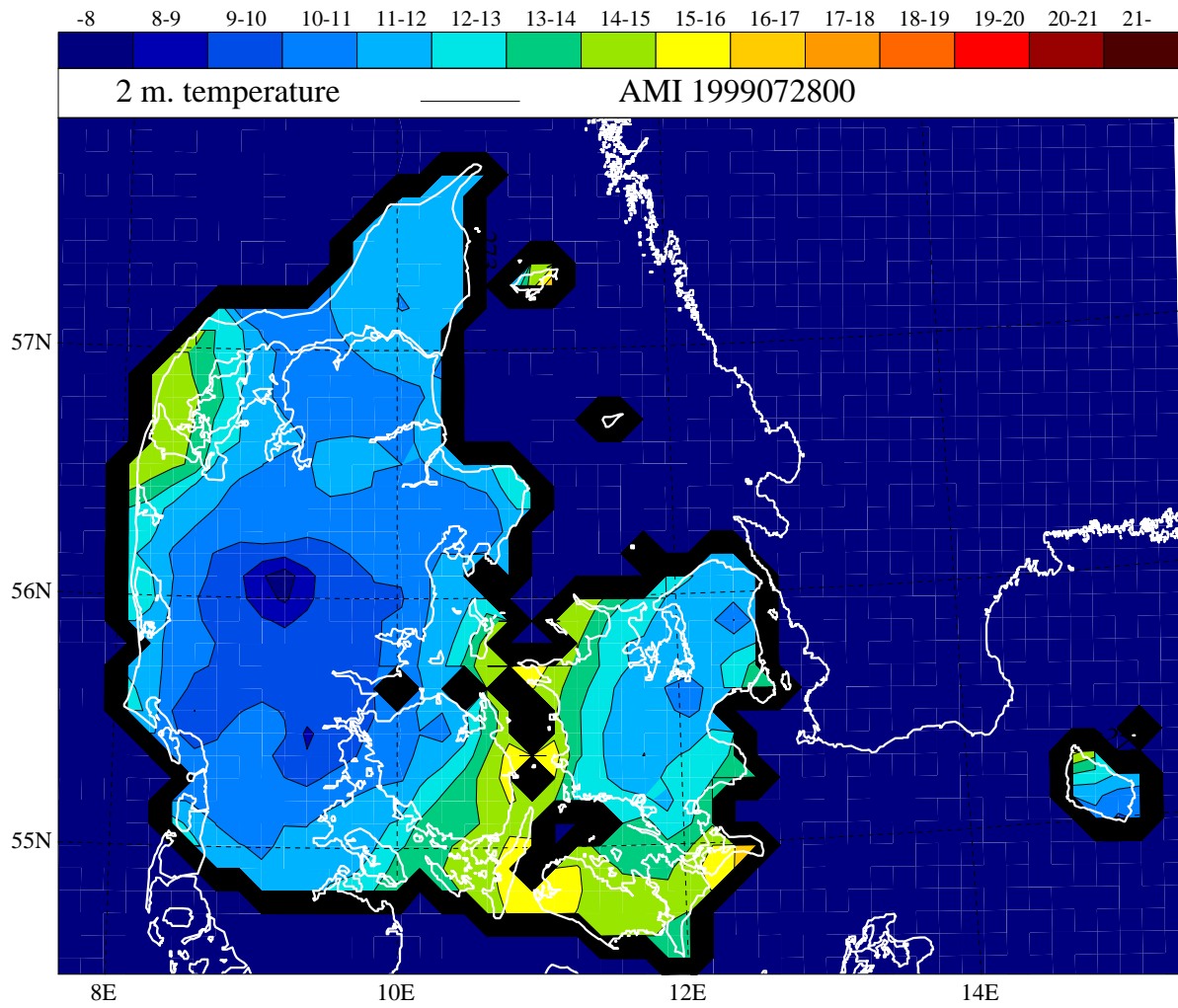


Figure 3.3.5 AMIS temperature analysis, July 28th, 1999, 00 UTC

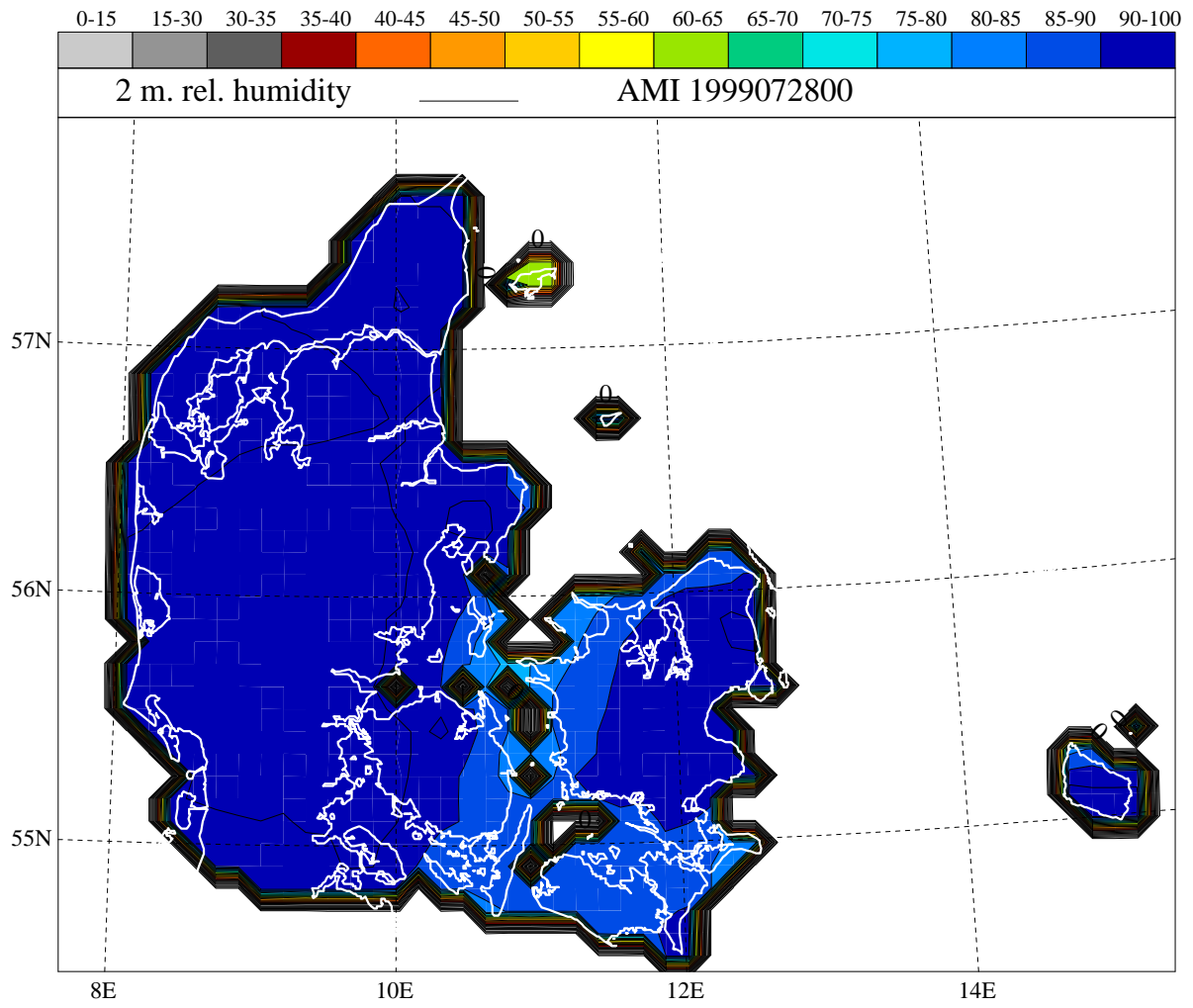


Figure 3.3.7 AMIS analysis of relative humidity, July 28th, 1999, 00 UTC

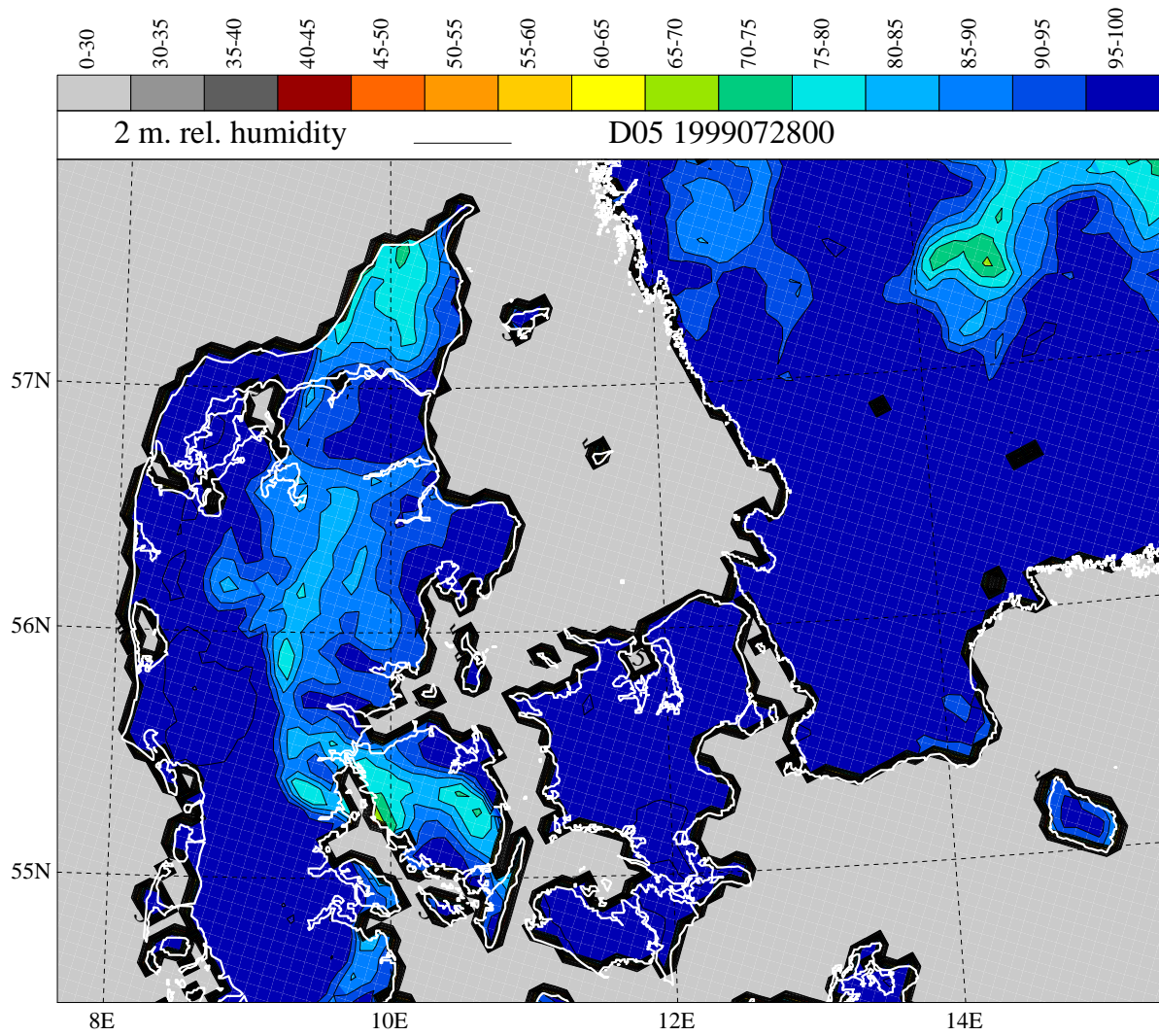


Figure 3.3.8 HIRLAM-D forecast of relative humidity, July 28th, 1999, 00 UTC

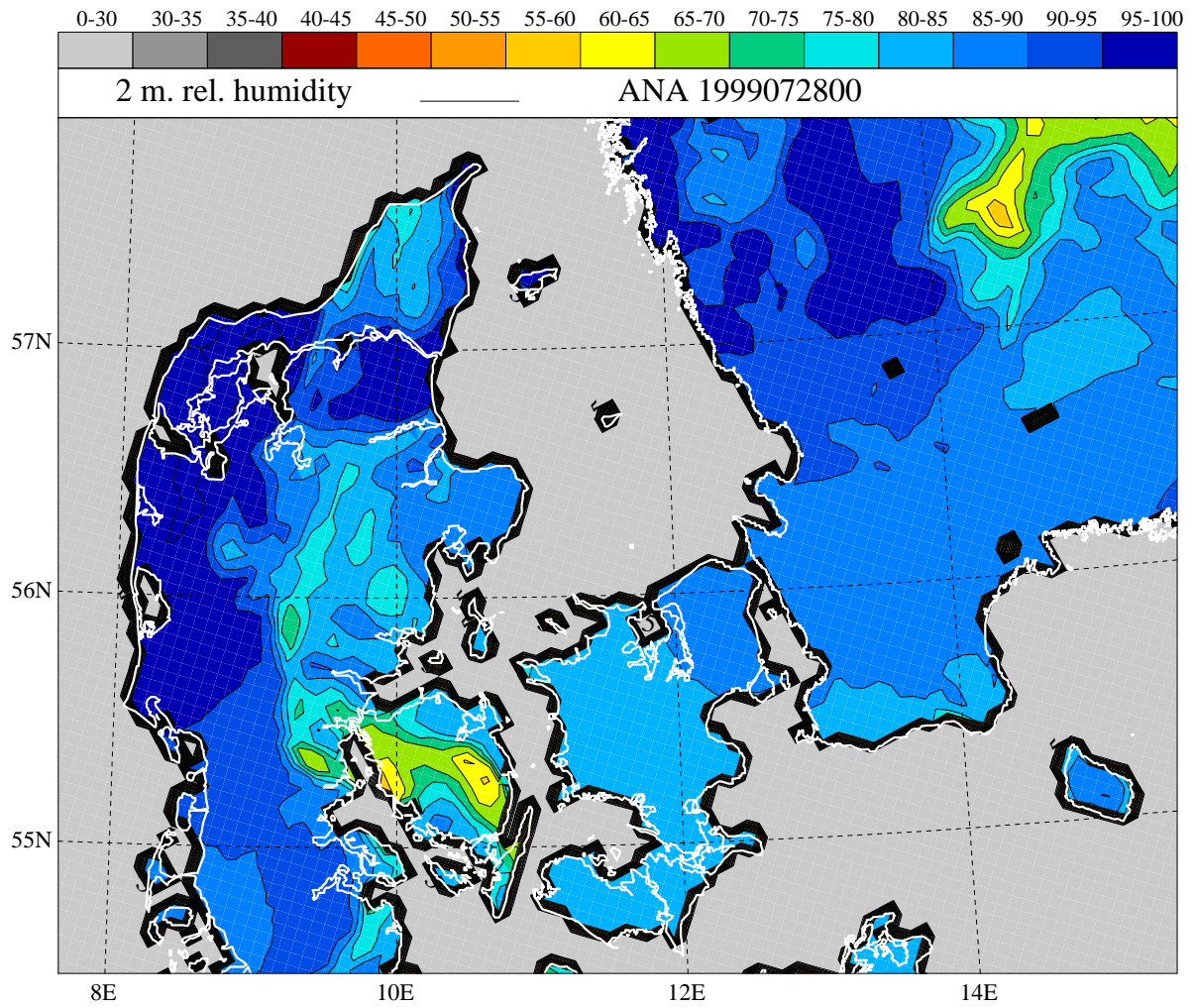


Figure 3.3.9 OI-analysis of relative humidity, July 28th, 1999, 00 UTC

3.4 Conclusions

The case studies show some characteristics of both AMIS and the analysis. AMIS completely relies on the observations and does not perform any error check. Thus, the quality of the fields depends mainly on the number of observations and the quality of each of them. Structures which are not caught by the observations are not caught in AMIS either. But the method is straightforward and fast.

The analysis of 2 m temperature and relative humidity makes use of HIRLAM forecasts and observations and combines these in an optimised way. But the cases show that especially the analysis of relative humidity does not always work satisfactorily. There is especially a tendency towards deterioration of the bias when the forecast already shows high values of relative humidity. On the other hand the forecast is able to catch strong gradients and other structures in more detail than observations can (see the cases from 5th of May and 28th of July), and these are also reflected in the analysis.

The analysis is better when temperature and humidity are determined by processes on the synoptic scale. This is presumably due to the fact that the first guess error correlations are determined for a large scale similar to the synoptic one. Thus, the analysis may lead to deterioration during weather conditions where local influences are dominant, like the case from 28th of July. The local conditions are actually represented in a more detailed manner in a model with higher resolution. This means that the occurrence of local effects has to be taken much more into account during the analysis. However, there are no investigations yet about the changes in the scale of the forecast error correlations when going to higher resolution, and the inhomogeneity of the forecast error also still plays a role. But further improvements in the analysis procedure with special concentration on these points seem to be feasible in the future.

4. Verification

4.1 Data

For the objective verification data from the whole verification period were used, i.e. April 21 to August 19, 1999. The verification period was divided into four sub-periods, each of about one months' length, cf. 1.4.

For both temperature and relative humidity, and for each of the three field types (AMIS, OI-analysis, HIRLAM-D), the field data were stratified according to month and observation hour, and verification was performed by comparing measured values from each of the 16 verification stations (see Table 1.1) to grid point values; for AMIS, the value at the grid 'square' to which the station belonged was used, for the other field types a value was interpolated from the four nearest grid points.

4.2 Verification Methods

The following verification measures were computed for each sample (cf. 1.4): ME, MAE, RMSE, and, in addition, HR1 and HR2 for temperature, HR5 and HR10 for relative humidity.

Summaries were produced in the form of means for all stations and/or months and/or observation hours.

In addition, time series for temperature at selected stations were inspected.

4.3 Results

Table 4.1 shows verification results for temperature and humidity for the whole period and each of the four observation hours, averaged over all 16 stations. Results for all data samples can be found in the Appendix. Below we comment on the results for each parameter separately.

Temperature All Months	ME		MAE		RMSE		HR 1		HR 2	
	OOUTC									
AMIS		0.53	1.03	1.89	5959	8621				
OI-analysis		0.38	1.12	1.43	5593	8338				
HIRLAM-D		-0.05	1.27	1.58	47.77	7868				

Temperature All Months	ME		MAE		RMSE		HR 1		HR 2	
	O6UTC									
AMIS		0.10	0.69	0.92	7946	9526				
OI-analysis		-0.10	0.84	1.11	69.91	9274				
HIRLAM-D		-0.73	1.14	1.44	5485	8418				

Temperature All Months	ME		MAE		RMSE		HR 1		HR 2	
	12 UTC									
AMIS		-0.17	0.94	1.26	67.52	8939				
OI-analysis		-0.01	1.21	1.58	5389	81.94				
HIRLAM-D		0.01	1.40	1.80	44.50	7606				

Temperature All Months	ME		MAE		RMSE		HR 1		HR 2	
	18 UTC									
AMIS		0.11	0.68	0.93	79.66	9519				
OI-analysis		0.20	0.93	1.24	65.67	9037				
HIRLAM-D		0.06	1.11	1.44	56.15	8470				

Relative Humidity All Months	ME		MAE		RMSE		HR 5		HR 10	
	OOUTC									
AMIS		-2.07	3.98	5.30	7076	9333				
OI-analysis		-4.39	6.26	8.07	5577	7950				
HIRLAM-D		-0.10	4.79	6.47	67.25	8756				

Relative Humidity All Months	ME		MAE		RMSE		HR 5		HR 10	
	O6UTC									
AMIS		-2.05	4.28	5.46	6854	9066				
OI-analysis		-1.43	5.25	6.85	6072	8670				
HIRLAM-D		-3.40	5.64	7.23	57.04	8203				

Relative Humidity All Months	ME		MAE		RMSE		HR 5		HR 10	
	12 UTC									
AMIS		0.97	6.32	8.29	5390	81.42				
OI-analysis		0.21	7.88	10.07	4211	6980				
HIRLAM-D		-6.34	9.62	11.81	3214	5962				

Relative Humidity All Months	ME		MAE		RMSE		HR 5		HR 10	
	18 UTC									
AMIS		-0.18	5.46	7.53	61.41	8491				
OI-analysis		-0.38	7.69	10.15	4405	7239				
HIRLAM-D		-4.55	8.76	11.24	3898	6527				

Table 4.1 Summary of verification statistics

4.3.1 Temperature

Looking first at the summary figures of Table 4.1, we see that the overall quality of the analysed temperature fields is quite high for all three analysis methods, with MAE values around 1°C and RMSE values always below 2°C. For most combinations of analysis method and observation time the bias is below 0.2°C by absolute value, although there are exceptions to this. Between 76 and 95 per cent of the verified field values fell within 2°C from the verifying observation.

As judged by MAE, RMSE and HR values, the AMIS method is for all four observation hours better than the OI-analysis, which is in turn better than HIRLAM-D. Thus, it seems that - at least in this setup - the OI method gives too much weight to the HIRLAM first-guess field and too little to the observations.

All analysis methods perform better at 06 and 18 UTC than at 00 and 12 UTC. This is presumably because the latter values tend to be more extreme.

The results shown in the Appendices (e.g., pages A10, B10, C10) show that there is quite a large variation between stations in the quality of the analyses. This holds for all three methods and observation hours, though most prominently for AMIS at 00 and 12 UTC. The following example illustrates the factors that may influence the quality of the analyses at each station.

Figure 4.31 and Figure 4.32 show time series of measured and analysed temperature for two stations, 0610 Billund and 0589 Rosvig Strand. The former is an inland station, the latter is situated by the sea (Figure 1.21). It is evident that all three analysis systems perform the better at the inland station where the temporal variability is less than at the coast. For both stations the AMIS curve follows the observations closer than the curves of the other analysis systems; in particular, the peaks and troughs in the observation series are better captured. The AMIS series for Billund fits the observations very well indeed.

No clear differences are found between the results for the four months (Appendices, pages A12, B12, C12).

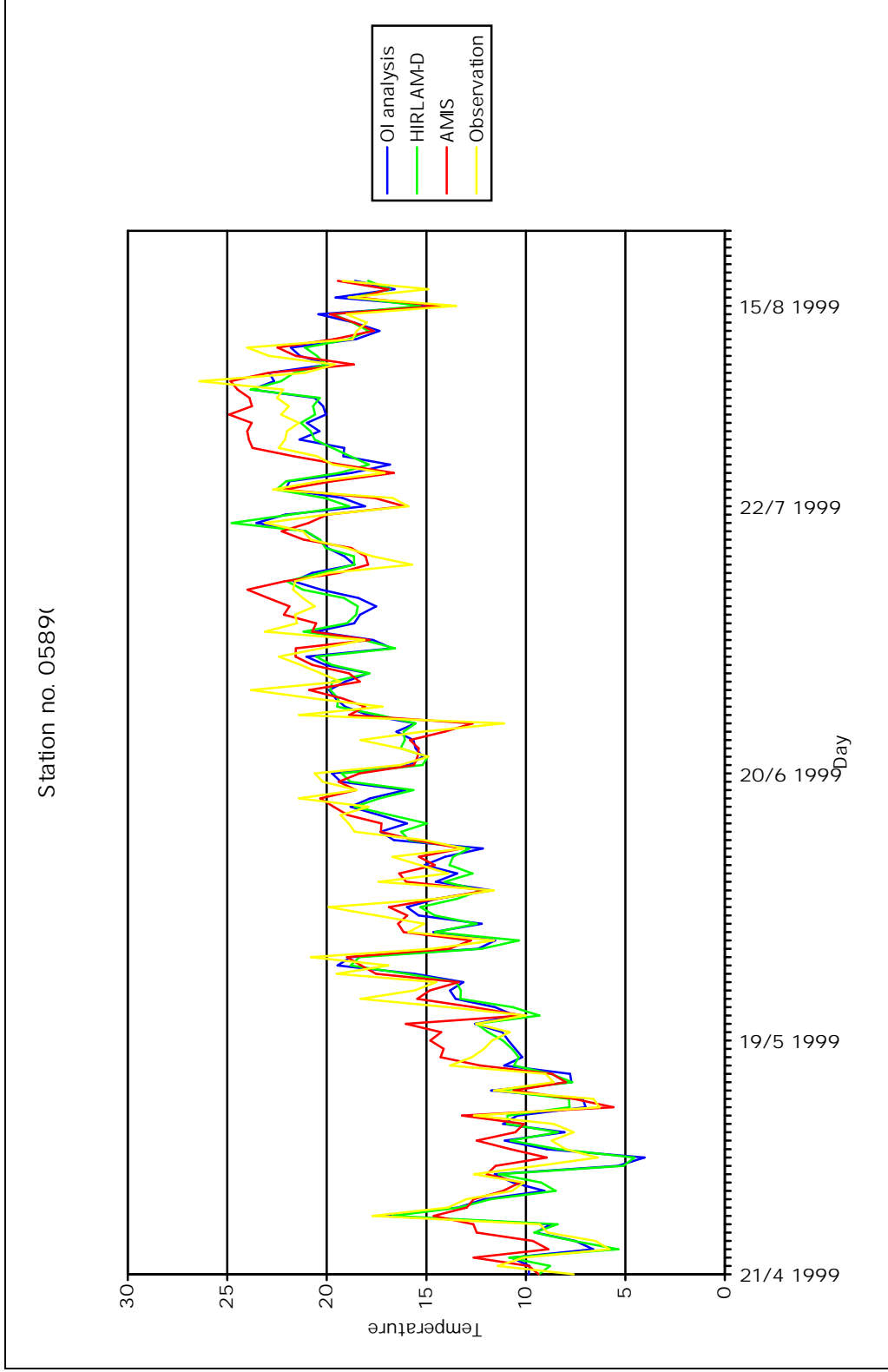


Figure 4.31 Time series of measured and analysed temperature for station 0589 Bønsvig Strand

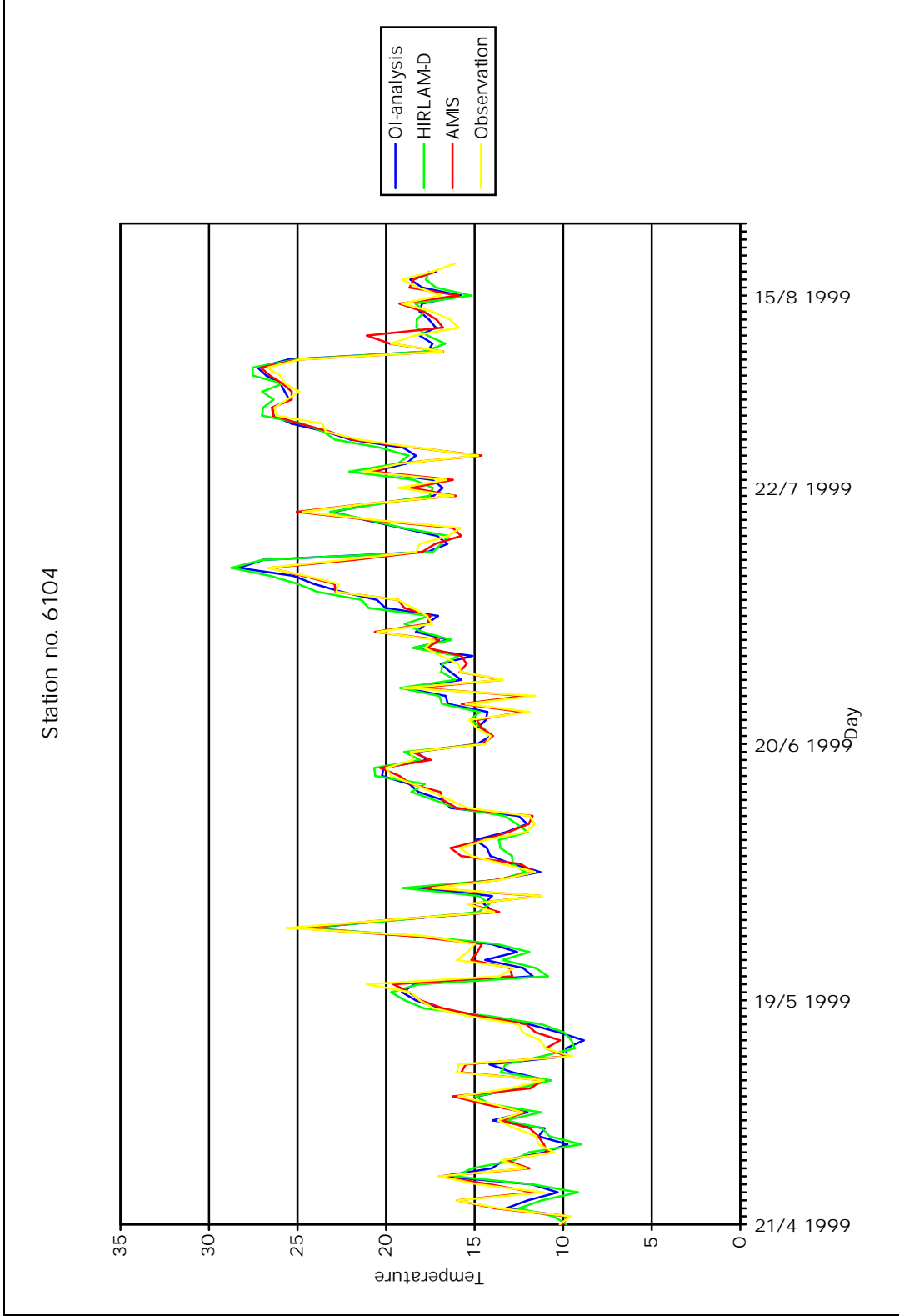


Figure 4.32 Time series of measured and analysed temperature for station 6104 Billund

4.3.2 Relative humidity

For relative humidity, the general quality as described by the figures Table 4.1 is good, but not excellent. MAE values of the three methods and the four observation hours range from 4 to 10%, and from 60 to 93 percent of the analysed values are correct within 10%. All methods perform best well at 12UTC, where - presumably - the horizontal variability of the relative humidity tends to be large.

Except at 00UTC where HIRLAM-D outperforms the OI-analysis, the AMIS fields have a higher quality than the OI fields which are better than the HIRLAM fields. Thus, once again, the OI-analysis does in general improve on the HIRLAM first guess by adjusting towards measured values, but AMIS is the best.

It should be noted here that some 10 stations which go into the AMIS gridding, for technical reasons are not used in the OI-analysis; this might explain part of the differences in quality.

As for temperature, there are quite large differences from station to station in how well the analysed data fit the observed values (Appendices, pages A 11, B11, C11). AMIS was better in months 2 and 3 than in months 1 and 4. HIRLAM-D and the OI-analysis were better in months 1 and 2 than in the remaining part of the verification period (Appendices, pages A 13, B13, C13).

4.4 Conclusions

To sum up, the verification shows that all three methods perform satisfactorily for both temperature and relative humidity, although the results for temperature are better than those for humidity. The OI surface analysis scheme improves on the HIRLAM first-guess but still the simple AMIS interpolation with ground observations as its sole data source and no built-in physics or information on surface characteristics does a better job in the mean.

5. Conclusions and Outlook

In the present study the quality of AMIS gridded fields of 2 metre temperature and relative humidity has been compared to that of the corresponding fields produced by the operational DMI-HIRLAM-D model and the HIRLAM Optimum Interpolation surface analysis scheme using the HIRLAM-D fields as first guess. The investigation has been carried out through case evaluation and statistical verification.

The immediate conclusions from both the case studies and the verification are that all three analysis methods work reasonably well, although better for temperature than for relative humidity. As measured by the statistics, AMIS performs best for both parameters, followed by the OI-analysis. The case evaluation supports this conclusion and also points to some important strengths and weaknesses of the three methods.

Through the cases it has been illustrated how the use of a high-resolution numerical weather prediction system in the analysis can confer features on scales which are not resolved by the observations to the fields, features which in the cases investigated here generally seem physically realistic. The humidity fields from HIRLAM and the OI-analysis may at times be quite poor.

The examples have also shown that the quality of the AMIS fields is very much dependent on the quality and availability of single observations; in particular, since only a coarse climatological check is performed on the input values, AMIS is very prone to observation errors which may ruin single fields locally.

How can it be that increasing the grid resolution and adding sophisticated physics and dynamics, surface physiography and analysis techniques to the gridding procedure actually impairs the quality of the resulting fields?

Part of the explanation lies probably with the fact that the OI-analysis scheme is tuned to perform well in a climate (the Spanish) which is more continental and less horizontally variable than the Danish one, and with a forecast model having a lower resolution than that of DMI-HIRLAM-D. Much could undoubtedly be gained from tuning and optimising the OI procedure for Danish applications.

The question posed bears upon a central issue in numerical weather prediction, namely that of the relation between, on one hand, increased spatial and temporal resolution in the models and the resulting sharper and more variable model fields - and, on the other, the quality of these fields as measured at single points. In general, larger variability will tend to give poorer point statistics, even when the variability is physically realistic. The way out of this dilemma is probably not to give up working on increased model sharpness and resolution, but, rather, to work in parallel on scientifically well-founded ways of quantifying the expected model errors, e.g., by the use of ensemble prediction techniques.

Looking a bit ahead in time, it is clear that substantial improvements in AMIS, especially as regards horizontal variations on scales not resolved by the raw observations, will have to be made through more intensive use of a numerical weather prediction system. Of interest here

is the change, planned for 2000, in the operational DMI-HIRLAM data assimilation system to a 3D variational scheme. This will allow new data types to be included in the assimilation, most importantly several new types of satellite data, and will also give a better use of the already ingoing data types. Surface observations from SYNO P, automatic climate, and road weather stations of parameters like temperature, relative humidity and, at a later stage, possibly even precipitation amount and intensity, will enter directly into the assimilation.

Of special interest to the agricultural community is the possibility of improving the representation of surface characteristics and the parameterisation of surface processes in DMI-HIRLAM; notably, the inclusion of land-use information, varying through the course of the season, and corresponding advancements in the parameterisation of vegetation, present intriguing possibilities for further improvements in the analysis and short-term forecasting of surface fields.

So, even if the immediate conclusions from this study do not point in that direction, it is expected that AMIS users in the coming years will benefit from closer connections between AMIS and the DMI-HIRLAM system.

6. References

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Appendix A

This appendix contains tables with detailed statistic of the verification of the AMIS field for each verifying station. The following parameters are used:

Month no. 1 April 21-May 20 1999
Month no. 2 May 21-June 20 1999
Month no. 3 June 21-July 20 1999
Month no. 4 July 21-August 19 1999

ME Mean Error, i.e. the sum of the difference between the analysed values and the observations, divided by the number of observations.
MAE Mean Absolute Error, i.e. the sum of the absolute difference between the analysed values and the observations, divided by the number of observations.
RMSE Root Mean Square Error, i.e. square root of the mean squared error.
HR 1 Hit Rate, i.e. the relative number of analysed value that are within +/- 1 degrees Celsius of the observed temperature.
HR 2 Hit Rate, i.e. the relative number of analysed value that are within +/- 2 degrees Celsius of the observed temperature.
HR 5 Hit Rate, i.e. the relative number of analysed value that are within +/- 5% of the observed relative humidity.
HR 10 Hit Rate, i.e. the relative number of analysed value that are within +/- 10% of the observed relative humidity.

All Hit Rates are given in percent hits.

ME, MAE and RMSE are in degree Celsius in tables showing temperature statistics and in percent humidity in tables showing relative humidity statistics.

Temperature Month no. 1 00 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.33	0.48	0.71	86.67	96.67
05090	-0.39	0.99	1.25	56.67	90.00
05170	-0.19	0.90	1.19	60.00	93.33
05360	0.21	0.55	0.73	90.00	96.67
05500	0.29	0.63	0.87	83.33	96.67
05640	0.17	0.69	0.83	80.00	96.67
05770	0.58	0.72	1.10	76.67	96.67
05890	-0.13	0.83	1.08	70.00	93.33
05910	0.71	1.11	1.54	63.33	76.67
05985	0.52	0.83	1.01	60.00	96.67
06096	-1.14	1.98	6.12	36.67	53.33
06104	0.03	0.68	2.17	73.33	93.33
06110	0.48	0.61	2.00	76.67	93.33
06124	0.60	0.81	1.02	70.37	92.59
06160	0.80	0.86	1.16	63.33	90.00
06169	-0.20	0.62	0.74	83.33	100.00
MEAN:	0.17	0.83	1.47	70.65	91.00

Temperature Month no. 1 06 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.44	0.56	0.76	83.33	96.67
05090	0.24	0.34	0.42	100.00	100.00
05170	0.32	0.65	0.85	80.00	96.67
05360	0.37	0.68	0.82	76.67	100.00
05500	-0.74	0.76	0.86	73.33	100.00
05640	0.18	0.58	0.77	86.67	96.67
05770	0.26	0.29	0.36	100.00	100.00
05890	0.15	0.52	0.64	93.33	100.00
05910	-0.20	0.63	0.76	83.33	100.00
05985	0.25	0.67	0.76	83.33	100.00
06096	-0.84	1.57	2.34	50.00	73.33
06104	0.21	0.47	0.80	86.67	93.33
06110	0.54	0.65	0.90	76.67	93.33
06124	-0.65	0.85	1.06	68.00	92.00
06160	0.71	0.84	1.46	76.67	83.33
06169	0.01	0.58	0.83	80.00	93.33
MEAN:	0.08	0.67	0.90	81.13	94.92

Temperature Month no. 1 12 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.12	0.42	0.51	89.66	100.00
05090	0.45	0.67	0.92	80.00	96.67
05170	0.26	0.73	0.97	76.67	96.67
05360	0.22	0.55	0.74	86.67	96.67
05500	-0.66	0.78	1.00	65.52	96.55
05640	-1.38	1.41	1.67	33.33	80.00
05770	-0.15	0.41	0.48	96.67	100.00
05890	1.16	1.87	2.19	36.67	53.33
05910	-2.34	2.34	2.60	10.34	37.93
05985	-0.63	1.48	1.90	43.33	80.00
06096	0.22	2.36	3.59	55.17	65.52
06104	-0.19	0.36	0.47	93.33	100.00
06110	-0.07	0.69	0.95	76.67	96.67
06124	-1.42	1.58	2.11	37.93	68.97
06160	-0.16	0.50	0.68	86.21	100.00
06169	0.56	0.99	1.15	46.67	93.33
MEAN:	-0.25	1.07	1.37	63.43	85.14

Temperature Month no. 1 18 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.17	0.24	0.32	96.67	100.00
05090	0.37	0.55	0.68	86.67	100.00
05170	0.41	0.57	0.75	80.00	96.67
05360	0.31	0.50	0.58	90.00	100.00
05500	-0.09	0.36	0.46	93.33	100.00
05640	-0.90	1.01	1.40	56.67	86.67
05770	-0.49	0.56	0.82	86.67	96.67
05890	0.14	1.06	1.27	50.00	90.00
05910	-1.22	1.24	1.49	46.67	80.00
05985	-0.15	0.80	1.09	66.67	93.33
06096	0.23	2.02	2.89	50.00	63.33
06104	-0.25	0.47	0.71	90.00	93.33
06110	0.22	0.48	0.61	90.00	100.00
06124	-0.40	0.60	0.78	89.66	96.55
06160	0.05	0.35	0.49	93.33	100.00
06169	0.47	0.59	0.69	90.00	100.00
MEAN:	-0.07	0.71	0.94	78.52	93.53

Temperature statistics for the 1st month at times 00, 06, 12 and 18 UTC.

Temperature Month no. 2 00UTC	ME	MAE	RMSE	HR 1	HR 2
0500	0.36	0.40	0.55	8710	10000
0500	0.40	0.77	0.93	6452	10000
0510	0.41	0.75	0.88	8065	10000
0530	0.69	0.74	0.91	6452	10000
0550	0.60	0.67	0.84	7097	10000
0560	1.14	1.20	1.42	3871	7742
0570	0.84	0.91	1.16	6452	8710
0580	0.32	1.03	1.30	5806	8710
0590	1.60	1.84	2.29	4194	5806
0595	0.60	0.95	1.14	6452	9355
0600	-0.05	2.14	2.63	1905	5714
0610	0.17	0.53	0.61	9355	10000
0610	0.70	0.80	0.99	6129	10000
0612	1.82	1.83	2.19	3103	5517
0616	0.67	0.72	0.92	7097	10000
0616	-0.34	0.61	0.79	8387	9677
MEAN:	0.62	0.99	1.22	6220	8827

Temperature Month no. 2 06UTC	ME	MAE	RMSE	HR 1	HR 2
0500	0.15	0.26	0.38	9355	10000
0500	0.37	0.39	0.48	9355	10000
0510	0.39	0.50	0.58	9355	10000
0530	0.38	0.47	0.57	9032	10000
0550	-0.45	0.57	0.73	8710	10000
0560	0.39	0.55	0.65	9032	10000
0570	0.04	0.19	0.29	9677	10000
0580	-1.21	1.37	1.85	4839	7419
0590	-0.24	0.38	0.50	9355	10000
0595	-0.08	0.70	0.89	8710	9677
0600	-0.83	2.29	2.76	1905	6190
0610	0.01	0.31	0.42	9677	10000
0610	0.73	0.81	1.11	7097	9032
0612	-0.55	0.90	1.14	7241	9310
0616	0.50	0.63	0.80	8065	10000
0616	0.22	0.44	0.55	9032	10000
MEAN:	-0.01	0.67	0.86	8152	9477

Temperature Month no. 2 12UTC	ME	MAE	RMSE	HR 1	HR 2
0500	0.29	0.70	0.84	7000	10000
0500	0.16	0.41	0.57	9677	9677
0510	0.17	0.60	0.78	8387	9677
0530	0.09	0.76	1.06	7419	9677
0550	-1.30	1.40	1.68	3871	7419
0560	-0.58	0.96	1.39	7097	9032
0570	-0.23	0.51	0.67	8710	9677
0580	-0.43	1.26	1.54	3871	8387
0590	-1.21	1.32	1.66	4516	8065
0595	-0.58	0.90	1.56	8387	9032
0600	-0.64	3.07	4.43	1429	5714
0610	-0.07	0.45	0.57	9355	10000
0610	-0.07	0.51	0.66	8387	10000
0612	-0.57	1.07	1.44	5333	8667
0616	-0.14	0.45	0.63	9000	9667
0616	0.50	0.61	0.81	7419	9355
MEAN:	-0.29	0.94	1.27	6866	9003

Temperature Month no. 2 18UTC	ME	MAE	RMSE	HR 1	HR 2
0500	0.30	0.39	0.52	9310	10000
0500	0.39	0.43	0.50	10000	10000
0510	0.23	0.50	0.63	8621	10000
0530	0.74	0.79	0.91	7586	9655
0550	-0.26	0.43	0.60	8621	10000
0560	-0.29	0.57	0.67	8621	10000
0570	-0.33	0.50	0.68	8966	9655
0580	-0.52	0.83	1.21	7241	9655
0590	-0.51	0.69	1.13	7931	8966
0595	-0.24	0.79	1.39	8621	8966
0600	-0.33	2.36	2.81	2632	5263
0610	-0.13	0.36	0.44	9655	10000
0610	0.12	0.41	0.49	9655	10000
0612	-0.10	0.62	0.81	7857	9643
0616	0.05	0.38	0.44	10000	10000
0616	0.22	0.63	0.78	8621	9655
MEAN:	-0.04	0.67	0.88	8371	9466

Temperature statistics for the 2nd month at times 00, 06, 12 and 18UTC.

Temperature Month no. 3 00 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.54	0.72	0.88	63.33	100.00
05090	1.00	1.06	1.30	50.00	86.67
05170	0.40	0.89	1.09	60.00	93.33
05360	0.78	0.81	1.00	66.67	96.67
05500	0.75	0.85	1.08	60.00	93.33
05640	1.54	1.68	1.90	23.33	70.00
05770	1.09	1.09	1.30	50.00	83.33
05890	0.60	1.39	1.61	40.00	73.33
05910	1.61	1.67	2.00	33.33	63.33
05985	1.32	1.40	1.57	26.67	83.33
06096	-0.25	0.72	1.02	80.00	95.00
06104	-0.22	0.69	0.96	76.67	93.33
06110	0.53	0.86	1.13	66.67	90.00
06124	1.62	2.40	2.76	17.86	46.43
06160	0.72	0.78	1.09	62.07	89.66
06169	-0.69	0.84	1.03	63.33	96.67
MEAN:	0.71	1.11	1.36	52.50	84.65

Temperature Month no. 3 06 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.22	0.42	0.59	90.00	100.00
05090	0.48	0.52	0.59	96.67	100.00
05170	0.39	0.60	0.68	83.33	100.00
05360	0.50	0.58	0.72	80.00	100.00
05500	-0.51	0.65	0.80	73.33	100.00
05640	0.48	0.61	0.72	80.00	100.00
05770	0.10	0.31	0.40	100.00	100.00
05890	-0.84	1.21	1.59	50.00	80.00
05910	0.17	0.48	0.69	86.67	96.67
05985	0.55	0.73	0.80	80.00	100.00
06096	-0.31	0.47	0.55	95.00	100.00
06104	0.10	0.60	0.71	86.67	100.00
06110	0.57	0.74	0.90	66.67	100.00
06124	-0.37	1.34	1.73	53.57	71.43
06160	0.51	0.60	0.70	83.33	100.00
06169	0.06	0.32	0.42	96.67	100.00
MEAN:	0.13	0.64	0.79	81.37	96.76

Temperature Month no. 3 12 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.32	0.50	0.82	90.00	96.67
05090	0.47	0.80	0.92	63.33	100.00
05170	0.44	0.77	0.97	76.67	93.33
05360	0.12	0.51	0.67	83.33	100.00
05500	-1.18	1.28	1.50	40.00	86.67
05640	-0.45	0.83	1.06	66.67	93.33
05770	-0.03	0.38	0.52	90.00	100.00
05890	-0.26	1.23	1.45	50.00	76.67
05910	-0.92	1.05	1.28	56.67	93.33
05985	0.07	1.27	1.55	50.00	76.67
06096	-0.14	0.35	0.45	95.45	100.00
06104	-0.09	0.34	0.43	96.67	100.00
06110	-0.24	0.66	0.86	76.67	100.00
06124	-0.91	2.08	2.66	31.03	55.17
06160	0.07	0.49	0.61	89.66	100.00
06169	0.47	0.78	1.04	60.00	96.67
MEAN:	-0.14	0.83	1.05	69.76	91.78

Temperature Month no. 3 18 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.39	0.45	0.55	90.00	100.00
05090	1.08	1.16	1.29	46.67	90.00
05170	0.77	0.83	0.96	73.33	100.00
05360	0.61	0.66	0.80	83.33	96.67
05500	-0.29	0.49	0.65	86.67	100.00
05640	-0.11	0.53	0.67	90.00	100.00
05770	0.11	0.33	0.43	96.67	100.00
05890	0.13	0.58	0.77	76.67	100.00
05910	-0.28	0.53	0.70	90.00	96.67
05985	0.51	1.00	1.17	56.67	93.33
06096	0.23	0.38	0.51	90.48	100.00
06104	0.00	0.51	0.62	90.00	100.00
06110	0.10	0.47	0.62	93.33	100.00
06124	-0.41	1.50	2.10	53.57	64.29
06160	0.23	0.49	0.63	93.33	100.00
06169	0.27	0.46	0.59	90.00	100.00
MEAN:	0.21	0.65	0.82	81.29	96.31

Temperature statistics for the 3rd month at times 00, 06, 12 and 18 UTC.

Temperature Month no. 4 00 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.34	0.68	1.06	80.00	96.67
05090	0.74	1.07	1.34	56.67	90.00
05170	-0.30	0.88	1.08	63.33	96.67
05360	0.59	0.72	0.88	76.67	100.00
05500	0.87	0.92	1.20	60.00	86.67
05640	1.48	1.51	1.86	36.67	76.67
05770	1.18	1.20	1.47	50.00	76.67
05890	0.75	1.49	1.78	36.67	73.33
05910	1.05	1.05	1.22	66.67	83.33
05985	1.79	1.79	2.00	23.33	60.00
06096	-0.61	0.92	1.25	62.50	87.50
06104	-0.29	1.04	1.38	66.67	76.67
06110	0.57	0.84	1.11	70.00	86.67
06124	1.88	1.89	2.33	32.14	53.57
06160	1.08	1.09	1.31	48.28	89.66
06169	-1.16	1.31	1.52	36.67	80.00
MEAN:	0.62	1.15	1.42	54.14	82.13

Temperature Month no. 4 06 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.40	0.63	0.81	86.21	96.55
05090	0.25	0.63	0.78	75.86	100.00
05170	0.00	0.66	0.76	86.21	100.00
05360	0.65	0.78	0.95	68.97	100.00
05500	-0.34	0.49	0.59	93.10	100.00
05640	0.69	0.73	0.87	72.41	100.00
05770	0.14	0.32	0.44	93.10	100.00
05890	-1.17	1.47	1.85	48.28	72.41
05910	0.34	0.37	0.42	100.00	100.00
05985	1.15	1.15	1.32	48.28	89.66
06096	-0.61	0.63	0.83	73.91	100.00
06104	0.24	0.54	0.72	82.76	100.00
06110	1.01	1.01	1.25	58.62	89.66
06124	-0.38	0.98	1.17	59.26	96.30
06160	1.44	1.44	1.84	48.28	75.86
06169	-0.36	0.51	0.71	93.10	96.55
MEAN:	0.22	0.77	0.96	74.27	94.81

Temperature Month no. 4 12 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.42	0.62	0.71	86.21	100.00
05090	0.64	0.99	1.28	65.52	89.66
05170	-0.08	0.81	1.11	75.86	93.10
05360	0.32	0.77	0.89	68.97	100.00
05500	-0.70	0.97	1.27	58.62	89.66
05640	-0.76	1.22	1.39	44.83	82.76
05770	0.07	0.77	0.88	86.21	96.55
05890	0.56	1.18	1.37	51.72	86.21
05910	-0.44	0.78	0.85	80.00	100.00
05985	0.08	1.10	2.95	48.28	82.76
06096	-0.05	0.42	0.58	92.00	100.00
06104	0.18	0.47	0.70	93.10	96.55
06110	0.38	0.71	0.83	82.76	100.00
06124	-1.02	1.34	1.69	46.43	75.00
06160	0.36	0.56	0.75	86.21	100.00
06169	1.12	1.29	1.64	51.72	79.31
MEAN:	0.07	0.88	1.18	69.90	91.97

Temperature Month no. 4 18 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.40	0.60	0.84	79.31	96.55
05090	1.52	1.52	1.67	20.69	75.86
05170	0.61	0.81	0.92	72.41	100.00
05360	1.12	1.12	1.46	62.07	89.66
05500	0.14	0.44	0.59	86.21	100.00
05640	-0.15	0.48	0.64	82.76	100.00
05770	0.18	0.48	0.61	93.10	100.00
05890	0.56	0.67	0.78	72.41	100.00
05910	0.06	0.42	0.43	100.00	100.00
05985	0.99	0.99	1.15	62.07	93.10
06096	0.17	0.41	0.51	95.45	100.00
06104	-0.34	0.56	0.73	82.76	100.00
06110	0.27	0.57	0.71	93.10	96.55
06124	-0.01	0.75	0.88	57.14	100.00
06160	0.42	0.56	0.70	79.31	100.00
06169	0.15	0.49	0.59	86.21	100.00
MEAN:	0.38	0.68	0.82	76.56	96.98

Temperature statistics for the 4th month at times 00, 06, 12 and 18 UTC.

Relative Humidity Month no. 1						
00 UTC	ME	MAE	RMSE	HR 5	HR 10	HR 10
05050	0.90	2.16	3.18	86.67	100.00	100.00
05090	1.74	4.20	5.64	60.00	93.33	93.33
05170	4.91	5.57	9.25	66.67	83.33	83.33
05360	-0.08	1.39	1.91	96.67	100.00	100.00
05500	-3.39	4.03	4.91	76.67	96.67	96.67
05640	-3.90	4.91	5.46	60.00	96.67	96.67
05770	-2.21	2.46	3.36	83.33	100.00	100.00
05910	0.22	3.17	4.39	80.00	93.33	93.33
05985	-0.05	3.33	5.05	73.33	93.33	93.33
06096	-0.44	7.79	10.26	50.00	66.67	66.67
06104	1.75	3.86	5.10	76.67	93.33	93.33
06110	-2.84	4.22	5.85	70.00	93.33	93.33
06124	-2.61	4.01	5.26	66.67	92.59	92.59
06160	-7.29	7.29	9.45	43.33	76.67	76.67
MEAN:	-0.95	4.17	5.65	70.71	91.38	91.38

Relative Humidity Month no. 1						
06 UTC	ME	MAE	RMSE	HR 5	HR 10	HR 10
05050	-0.98	2.71	4.05	86.67	96.67	96.67
05090	-0.04	2.88	4.02	80.00	96.67	96.67
05170	1.68	3.48	4.99	83.33	93.33	93.33
05360	-1.89	2.83	4.47	73.33	93.33	93.33
05500	-0.83	4.39	5.12	63.33	96.67	96.67
05640	-5.98	6.03	6.85	50.00	90.00	90.00
05770	-1.42	1.60	2.05	100.00	100.00	100.00
05910	1.12	4.09	5.18	70.00	90.00	90.00
05985	0.46	2.56	4.33	90.00	93.33	93.33
06096	-0.29	9.14	11.89	50.00	56.67	56.67
06104	-1.67	3.17	4.02	80.00	100.00	100.00
06110	-2.50	4.18	5.90	66.67	93.33	93.33
06124	0.28	3.51	4.94	72.00	92.00	92.00
06160	-8.19	8.19	9.98	33.33	70.00	70.00
MEAN:	-1.45	4.20	5.55	71.33	90.14	90.14

Relative Humidity Month no. 1						
12 UTC	ME	MAE	RMSE	HR 5	HR 10	HR 10
05050	-0.51	2.33	2.79	96.55	100.00	100.00
05090	1.57	4.90	6.64	63.33	86.67	86.67
05170	3.87	6.25	7.48	46.67	73.33	73.33
05360	1.05	4.36	5.79	63.33	90.00	90.00
05500	-0.36	7.60	8.86	34.48	65.52	65.52
05640	5.24	7.55	8.81	30.00	76.67	76.67
05770	0.85	2.53	3.53	86.67	96.67	96.67
05910	16.47	16.73	19.04	17.24	27.59	27.59
05985	4.80	7.76	9.84	46.67	70.00	70.00
06096	-5.65	20.89	28.37	24.14	51.72	51.72
06104	0.30	4.34	5.72	70.00	93.33	93.33
06110	-1.08	5.67	7.26	63.33	86.67	86.67
06124	3.44	7.80	9.88	37.93	72.41	72.41
06160	-4.81	6.36	7.34	34.48	86.21	86.21
MEAN:	1.80	7.50	9.38	51.06	76.91	76.91

Relative Humidity Month no. 1						
18 UTC	ME	MAE	RMSE	HR 5	HR 10	HR 10
05050	0.49	2.18	3.15	86.67	100.00	100.00
05090	1.31	4.48	6.82	73.33	86.67	86.67
05170	2.41	5.24	7.15	63.33	86.67	86.67
05360	0.43	3.09	4.99	83.33	93.33	93.33
05500	-2.40	7.33	8.92	30.00	80.00	80.00
05640	4.35	8.07	10.75	50.00	66.67	66.67
05770	3.34	4.29	6.34	70.00	93.33	93.33
05910	10.47	10.75	13.01	26.67	46.67	46.67
05985	3.36	5.43	7.38	63.33	80.00	80.00
06096	-6.52	19.44	25.41	30.00	43.33	43.33
06104	1.82	4.16	6.33	76.67	90.00	90.00
06110	-3.12	5.07	6.65	56.67	86.67	86.67
06124	0.18	6.14	8.30	62.07	79.31	79.31
06160	-5.17	5.90	7.08	46.67	83.33	83.33
MEAN:	0.78	6.54	8.73	58.48	79.71	79.71

Relative humidity statistics for the 1st month at times 00, 06, 12 and 18 UTC

Relative Humidity Month no. 2						
00 UTC	ME	MAE	RMSE	HR 5	HR 10	
05050	0.06	0.89	1.40	100.00	100.00	
05090	-2.05	2.35	2.62	96.77	100.00	
05170	0.76	1.75	2.90	87.10	96.77	
05360	-0.43	1.24	1.64	100.00	100.00	
05500	-7.06	7.06	7.53	16.13	87.10	
05640	-5.83	6.55	6.83	22.58	96.77	
05770	-2.68	2.91	3.78	80.65	100.00	
05910	-2.71	4.73	6.03	67.74	90.32	
05985	0.28	4.14	5.47	70.97	90.32	
06096	1.72	4.00	5.00	71.43	90.48	
06104	-1.57	2.42	2.88	93.55	100.00	
06110	-2.81	3.35	3.99	83.87	100.00	
06124	-4.49	4.86	5.67	58.62	93.10	
06160	-5.47	5.47	5.97	48.39	93.55	
MEAN:	-2.31	3.69	4.41	71.27	95.60	

Relative Humidity Month no. 2						
06 UTC	ME	MAE	RMSE	HR 5	HR 10	
05050	0.08	1.86	2.67	93.55	100.00	
05090	-2.05	2.70	3.08	96.77	100.00	
05170	0.36	2.48	3.06	83.87	100.00	
05360	-3.90	4.23	5.66	67.74	90.32	
05500	-5.73	5.73	6.62	54.84	90.32	
05640	-8.19	8.20	8.90	16.13	74.19	
05770	-0.55	1.77	2.13	96.77	100.00	
05910	-1.81	3.92	4.99	64.52	96.77	
05985	1.11	3.50	4.56	74.19	93.55	
06096	2.28	7.25	8.90	42.86	66.67	
06104	-4.79	5.76	6.52	51.61	93.55	
06110	-2.05	3.26	4.00	77.42	100.00	
06124	0.34	4.50	5.65	68.97	93.10	
06160	-8.43	8.43	9.02	16.13	67.74	
MEAN:	-2.38	4.54	5.41	64.67	90.44	

Relative Humidity Month no. 2						
12 UTC	ME	MAE	RMSE	HR 5	HR 10	
05050	-0.31	3.84	4.88	66.67	96.67	
05090	2.39	4.64	5.53	54.84	96.77	
05170	2.66	4.96	6.20	61.29	90.32	
05360	-1.42	4.69	6.01	70.97	87.10	
05500	-7.22	7.80	9.72	35.48	77.42	
05640	-2.61	5.63	6.94	48.39	87.10	
05770	0.05	2.91	3.87	87.10	96.77	
05910	9.04	10.45	12.23	22.58	51.61	
05985	5.56	6.06	7.91	41.94	77.42	
06096	-0.63	15.49	18.71	14.29	33.33	
06104	-1.73	4.89	6.18	61.29	90.32	
06110	-0.78	3.93	5.05	77.42	96.77	
06124	-1.05	5.08	6.55	50.00	96.67	
06160	-6.10	6.47	7.24	30.00	83.33	
MEAN:	-0.15	6.20	7.64	51.59	82.97	

Relative Humidity Month no. 2						
18 UTC	ME	MAE	RMSE	HR 5	HR 10	
05050	0.31	2.33	3.06	86.21	100.00	
05090	-0.21	2.94	3.82	89.66	96.55	
05170	2.12	3.65	4.98	72.41	93.10	
05360	-2.29	2.81	5.45	93.10	93.10	
05500	-5.43	5.89	6.98	37.93	86.21	
05640	-1.85	4.36	5.16	62.07	96.55	
05770	0.81	3.23	4.10	72.41	100.00	
05910	5.87	6.99	9.42	51.72	72.41	
05985	4.76	5.51	7.30	55.17	86.21	
06096	-1.09	9.51	11.47	31.58	52.63	
06104	-0.45	2.84	3.37	82.76	100.00	
06110	-2.63	4.21	5.38	68.97	96.55	
06124	-1.85	5.14	6.81	57.14	78.57	
06160	-6.44	6.88	7.86	32.14	82.14	
MEAN:	-0.60	4.74	6.08	63.81	88.15	

Relative humidity statistics for the 2nd month at times 00, 06, 12 and 18 UTC

Relative Humidity Month no. 3 00 UTC						
ME	MAE	RMSE	HR 5	HR 10		
-1.25	3.04	3.81	86.67	96.67		
-4.13	4.27	5.32	70.00	90.00		
0.74	2.18	3.67	90.00	93.33		
-1.10	1.65	2.24	96.67	100.00		
-4.46	4.46	5.65	63.33	90.00		
-4.90	4.90	5.68	50.00	93.33		
-3.81	3.81	4.64	73.33	96.67		
-5.07	5.37	6.65	53.33	86.67		
-0.33	2.36	3.54	93.33	96.67		
3.30	3.45	3.98	80.00	100.00		
0.27	2.11	3.15	90.00	100.00		
-2.01	2.70	3.79	76.67	100.00		
-5.35	6.35	7.57	46.43	82.14		
-6.65	6.65	7.61	41.38	86.21		
-2.48	3.81	4.81	72.22	93.69		
MEAN:						

Relative Humidity Month no. 3 06 UTC						
ME	MAE	RMSE	HR 5	HR 10		
-0.02	2.98	3.75	83.33	100.00		
-2.00	4.34	5.27	56.67	93.33		
0.15	2.70	3.95	90.00	96.67		
-3.28	4.04	5.66	66.67	90.00		
-2.85	4.17	5.37	70.00	93.33		
-5.78	6.07	7.25	53.33	80.00		
-1.82	2.47	3.10	90.00	100.00		
-3.20	4.96	6.23	56.67	86.67		
0.59	2.27	2.93	86.67	100.00		
2.62	3.11	3.87	85.00	100.00		
-2.88	5.07	6.16	60.00	90.00		
-0.54	2.19	2.70	96.67	100.00		
0.16	4.86	6.34	60.71	85.71		
-8.46	8.54	9.24	16.67	63.33		
-1.95	4.13	5.13	69.46	91.36		
MEAN:						

Relative Humidity Month no. 3 12 UTC						
ME	MAE	RMSE	HR 5	HR 10		
1.41	2.76	3.71	80.00	100.00		
0.54	5.98	7.51	50.00	73.33		
-0.42	3.91	5.11	83.33	90.00		
0.00	3.73	4.79	73.33	93.33		
0.31	4.66	6.17	63.33	96.67		
0.55	5.66	6.79	43.33	80.00		
-2.26	3.53	5.23	86.67	93.33		
8.08	8.85	10.61	30.00	56.67		
5.66	6.88	8.45	50.00	70.00		
-0.33	3.98	4.75	63.64	100.00		
0.65	3.39	5.31	76.67	93.33		
0.44	4.19	5.21	53.33	96.67		
1.87	8.29	11.28	48.28	72.41		
-4.29	5.68	6.77	44.83	82.76		
0.87	5.11	6.55	60.48	85.61		
MEAN:						

Relative Humidity Month no. 3 18 UTC						
ME	MAE	RMSE	HR 5	HR 10		
0.55	2.69	3.65	86.67	96.67		
-3.62	5.63	7.22	56.67	83.33		
-2.27	3.62	4.67	66.67	93.33		
-4.15	5.53	8.08	53.33	86.67		
-0.48	3.05	4.45	83.33	93.33		
1.32	4.88	5.74	56.67	96.67		
-1.74	2.84	3.62	76.67	100.00		
4.06	6.44	8.03	46.67	76.67		
3.34	4.42	5.85	70.00	90.00		
1.04	3.31	3.77	90.48	100.00		
1.90	5.44	6.88	60.00	80.00		
-1.14	3.56	5.02	73.33	93.33		
0.39	7.78	10.41	53.57	71.43		
-6.74	6.96	8.43	40.00	73.33		
-0.54	4.72	6.13	65.29	88.20		
MEAN:						

Relative humidity statistics for the 3rd month at times 00, 06, 12 and 18 UTC

Relative Humidity Month no. 4						
00 UTC	ME	MAE	RMSE	HR 5	HR 10	
05050	-0.44	3.82	8.66	90.00	96.67	
05090	-5.28	5.77	6.72	50.00	90.00	
05170	1.85	2.60	4.40	86.67	93.33	
05360	-0.71	1.93	2.48	96.67	100.00	
05500	-5.87	6.07	7.38	43.33	90.00	
05640	-3.66	3.83	4.28	73.33	100.00	
05770	-2.77	2.78	3.60	86.67	100.00	
05910	-4.39	4.47	5.05	33.33	100.00	
05985	-2.44	3.14	3.98	76.67	100.00	
06096	2.70	3.68	4.55	70.83	100.00	
06104	0.44	2.95	4.15	83.33	96.67	
06110	-3.88	4.42	5.38	60.00	90.00	
06124	-4.72	5.90	7.28	46.43	78.57	
06160	-6.87	6.87	7.71	48.28	75.86	
MEAN:	-2.57	4.16	5.40	67.54	93.65	

Relative Humidity Month no. 4						
06 UTC	ME	MAE	RMSE	HR 5	HR 10	
05050	-1.11	4.22	5.00	68.97	93.10	
05090	-3.60	5.16	6.01	51.72	89.66	
05170	0.67	3.18	4.58	86.21	93.10	
05360	-3.42	3.81	4.77	68.97	100.00	
05500	-4.20	4.32	5.79	65.52	89.66	
05640	-6.27	6.27	6.73	31.03	89.66	
05770	-0.61	2.32	2.85	89.66	100.00	
05910	-2.87	2.87	3.10	100.00	100.00	
05985	-1.21	3.59	5.10	72.41	93.10	
06096	2.12	3.29	4.95	82.61	91.30	
06104	-2.86	3.48	4.11	82.76	96.55	
06110	-2.17	2.47	3.40	89.66	96.55	
06124	0.28	3.44	4.31	77.78	96.30	
06160	-8.93	8.93	9.93	27.59	55.17	
MEAN:	-2.44	4.10	5.05	71.06	91.73	

Relative Humidity Month no. 4						
12 UTC	ME	MAE	RMSE	HR 5	HR 10	
05050	0.34	3.97	5.26	72.41	89.66	
05090	-0.51	6.09	8.47	58.62	75.86	
05170	3.10	6.68	8.71	48.28	79.31	
05360	-1.27	4.96	6.67	65.52	86.21	
05500	-1.64	4.58	5.72	58.62	96.55	
05640	5.07	7.89	9.42	34.48	65.52	
05770	0.04	3.89	4.77	79.31	93.10	
05910	5.50	7.95	9.03	20.00	60.00	
05985	9.96	11.79	14.66	24.14	51.72	
06096	-1.71	4.61	5.53	68.00	92.00	
06104	-0.63	4.89	5.76	55.17	93.10	
06110	-1.88	4.34	5.60	58.62	93.10	
06124	5.79	8.11	10.45	35.71	75.00	
06160	-5.32	6.41	8.53	51.72	79.31	
MEAN:	1.20	6.15	7.76	52.19	80.75	

Relative Humidity Month no. 4						
18 UTC	ME	MAE	RMSE	HR 5	HR 10	
05050	1.82	4.64	7.05	75.86	89.66	
05090	-6.02	7.70	9.19	34.48	68.97	
05170	-1.20	4.46	5.83	62.07	89.66	
05360	-3.71	5.83	8.41	62.07	79.31	
05500	-1.84	4.19	5.71	68.97	89.66	
05640	5.49	7.27	9.86	51.72	72.41	
05770	-0.68	4.07	5.17	68.97	93.10	
05910	4.39	5.14	6.08	60.00	80.00	
05985	3.14	5.11	6.98	62.07	86.21	
06096	-2.21	5.03	7.14	54.55	90.91	
06104	2.02	4.76	6.90	72.41	86.21	
06110	-4.03	5.63	7.79	55.17	93.10	
06124	1.77	6.01	7.50	53.57	89.29	
06160	-4.53	5.66	7.03	51.72	82.76	
MEAN:	-0.40	5.39	7.19	59.55	85.09	

Relative humidity statistics for the 4th month at times 00, 06, 12 and 18 UTC

Temperature All Months		ME	MAE	RMSE	HR 1	HR 2
00UTC		0.39	0.57	0.82	7934	9835
05050		0.44	0.97	1.22	5702	9174
05170		0.08	0.85	1.06	6612	9587
05360		0.57	0.70	0.89	7438	9835
05500		0.63	0.77	1.01	6860	9421
05640		1.08	1.27	1.56	4463	8017
05770		0.92	0.98	1.27	6033	8595
05890		0.39	1.18	1.46	5124	8182
05910		1.29	1.51	1.94	4742	6701
05985		1.05	1.24	1.48	4380	8347
06096		-0.57	1.49	6.48	4842	7158
06104		-0.08	0.74	3.33	7769	9091
06110		0.57	0.78	3.40	6860	9256
06124		1.49	1.74	2.18	3750	6161
06160		0.81	0.86	1.13	6134	9244
06169		-0.60	0.84	1.07	6694	9339
MEAN:		0.53	1.03	1.89	5959	8621

Temperature All Months		ME	MAE	RMSE	HR 1	HR 2
06UTC		0.30	0.46	0.65	8833	9833
05090		0.34	0.47	0.58	9167	10000
05170		0.28	0.60	0.72	8583	9917
05360		0.47	0.63	0.78	7917	10000
05500		-0.51	0.62	0.75	8167	10000
05640		0.43	0.61	0.75	8250	9917
05770		0.13	0.27	0.37	9750	10000
05890		-0.77	1.14	1.56	6000	8167
05910		-0.06	0.49	0.65	8866	9897
05985		0.46	0.81	0.97	7500	9667
06096		-0.67	1.27	1.92	5851	8298
06104		0.14	0.48	0.68	8833	9833
06110		0.71	0.80	1.05	6833	9333
06124		-0.49	1.02	1.31	6330	8807
06160		0.78	0.87	1.28	7250	9000
06169		-0.01	0.46	0.65	9000	9750
MEAN:		0.10	0.69	0.92	7946	9526

Temperature All Months		ME	MAE	RMSE	HR 1	HR 2
12UTC		0.29	0.56	0.73	8390	9915
05050		0.42	0.71	0.95	7667	9583
05170		0.20	0.73	0.96	7833	9500
05360		0.19	0.65	0.85	7833	9833
05500		-0.97	1.11	1.39	5042	8655
05640		-0.79	1.10	1.39	5417	8667
05770		-0.09	0.51	0.65	9000	9833
05890		0.25	1.39	1.67	4417	7500
05910		-1.42	1.52	1.87	4000	7263
05985		-0.27	1.19	1.59	5667	8250
06096		-0.12	1.56	2.87	6495	8041
06104		-0.04	0.40	0.55	9417	9917
06110		-0.01	0.64	0.83	8000	9917
06124		-0.98	1.52	2.03	4224	7155
06160		0.03	0.50	0.67	8803	9915
06169		0.66	0.91	1.19	5833	9083
MEAN:		-0.17	0.94	1.26	6752	8939

Temperature All Months		ME	MAE	RMSE	HR 1	HR 2
18UTC		0.31	0.42	0.59	8983	9915
05050		0.84	0.91	1.13	6356	9153
05170		0.51	0.68	0.83	7797	9915
05360		0.69	0.76	0.99	7797	9576
05500		-0.13	0.43	0.58	8814	10000
05640		-0.36	0.65	0.91	7881	9661
05770		-0.13	0.47	0.65	9153	9831
05890		0.08	0.79	1.03	6780	9661
05910		-0.63	0.80	1.13	7340	8936
05985		0.27	0.89	1.20	6780	9237
06096		0.10	1.33	2.12	6522	7826
06104		-0.18	0.48	0.64	8983	9831
06110		0.18	0.48	0.61	9322	9915
06124		-0.23	0.86	1.27	6991	8938
06160		0.19	0.45	0.57	9145	10000
06169		0.28	0.54	0.67	8814	9915
MEAN:		0.11	0.68	0.93	7966	9519

Temperature statistics for all months at times 00, 06, 12 and 18UTC

Relative Humidity						
All Months						
00 UTC	ME	MAE	RMSE	HR 5	HR 10	
06096	1.62	5.00	6.88	66.32	87.37	
06104	0.21	2.83	3.91	85.95	97.52	
06110	-2.88	3.67	4.83	72.73	95.87	
06124	-4.31	5.29	6.52	54.46	86.61	
06160	-6.56	6.56	7.77	45.38	83.19	
05050	-0.18	2.47	5.02	90.91	98.35	
05090	-2.43	4.13	5.28	69.42	93.39	
05170	2.06	3.01	5.61	82.64	91.74	
05360	-0.58	1.55	2.09	97.52	100.00	
05500	-5.21	5.42	6.47	49.59	90.91	
05640	-4.59	5.07	5.65	51.24	96.69	
05770	-2.87	2.99	3.88	80.99	99.17	
05910	-2.64	4.43	5.73	64.95	90.72	
05985	-0.63	3.25	4.59	78.51	95.04	
MEAN:	-2.07	3.98	5.30	70.76	93.33	

Relative Humidity						
All Months						
06 UTC	ME	MAE	RMSE	HR 5	HR 10	
06096	1.49	6.00	8.48	63.83	76.60	
06104	-3.06	4.39	5.35	68.33	95.00	
06110	-1.81	3.03	4.18	82.50	97.50	
06124	0.26	4.10	5.39	69.72	91.74	
06160	-8.50	8.52	9.54	23.33	64.17	
05050	-0.50	2.92	3.94	83.33	97.50	
05090	-1.91	3.75	4.71	71.67	95.00	
05170	0.71	2.95	4.20	85.83	95.83	
05360	-3.12	3.73	5.17	69.17	93.33	
05500	-3.41	4.66	5.76	63.33	92.50	
05640	-6.57	6.66	7.50	37.50	83.33	
05770	-1.10	2.03	2.57	94.17	100.00	
05910	-1.40	4.23	5.37	65.98	91.75	
05985	0.26	2.98	4.30	80.83	95.00	
MEAN:	-2.05	4.28	5.46	68.54	90.66	

Relative Humidity						
All Months						
12 UTC	ME	MAE	RMSE	HR 5	HR 10	
05050	0.24	3.23	4.27	78.81	96.61	
05090	1.02	5.39	7.10	56.67	83.33	
05170	2.30	5.43	6.98	60.00	83.33	
05360	-0.41	4.43	5.85	68.33	89.17	
05500	-2.29	6.18	7.83	47.90	84.03	
05640	2.00	6.67	8.05	39.17	77.50	
05770	-0.33	3.21	4.40	85.00	95.00	
05910	10.82	11.73	14.12	23.16	46.32	
05985	6.46	8.08	10.49	40.83	67.50	
06096	-2.34	11.69	18.15	42.27	69.07	
06104	-0.36	4.38	5.75	65.83	92.50	
06110	-0.82	4.53	5.84	63.33	93.33	
06124	2.45	7.29	9.68	43.10	79.31	
06160	-5.14	6.23	7.50	40.17	82.91	
MEAN:	0.97	6.32	8.29	53.90	81.42	

Relative Humidity						
All Months						
18 UTC	ME	MAE	RMSE	HR 5	HR 10	
05050	0.79	2.95	4.52	83.90	96.61	
05090	-2.12	5.19	7.03	63.56	83.90	
05170	0.26	4.25	5.74	66.10	90.68	
05360	-2.42	4.31	6.90	72.88	88.14	
05500	-2.52	5.12	6.73	55.08	87.29	
05640	2.34	6.15	8.26	55.08	83.05	
05770	0.44	3.60	4.93	72.03	96.61	
05910	6.68	7.91	10.20	42.55	65.96	
05985	3.64	5.11	6.90	62.71	85.59	
06096	-2.64	10.26	15.91	50.00	69.57	
06104	1.33	4.31	6.06	72.88	88.98	
06110	-2.72	4.61	6.30	63.56	92.37	
06124	0.12	6.27	8.36	56.64	79.65	
06160	-5.72	6.35	7.62	42.74	80.34	
MEAN:	-0.18	5.46	7.53	61.41	84.91	

Relative humidity statistics for all months at times 00, 06, 12 and 18 UTC

Temperature Month no. 1 All Hours		ME	MAE	RMSE	HR 1	HR 2
0505	0.27	0.42	0.60	8908	9832	
0509	0.17	0.64	0.87	8083	9667	
0517	0.20	0.71	0.96	7417	9583	
0536	0.28	0.57	0.72	8583	9833	
0550	-0.30	0.63	0.82	7899	9832	
0564	-0.48	0.92	1.23	6417	9000	
0577	0.05	0.49	0.75	9000	9833	
0589	0.33	1.07	1.41	6250	8417	
0597	-0.75	1.32	1.72	5126	7395	
0598	0.00	0.95	1.27	6333	9250	
0609	-0.39	1.98	9.55	4790	6387	
0610	-0.05	0.50	2.48	8583	9500	
0617	0.29	0.60	2.77	8000	9583	
0618	-0.48	0.97	1.36	6636	8727	
0619	0.35	0.64	1.02	7983	9328	
0619	0.21	0.69	0.87	7500	9667	
MEAN:	-0.02	0.82	1.77	7344	9115	

Temperature Month no. 2 All Hours		ME	MAE	RMSE	HR 1	HR 2
0505	0.27	0.44	0.59	8595	10000	
0509	0.33	0.50	0.65	8852	9918	
0517	0.30	0.59	0.73	8607	9918	
0536	0.47	0.69	0.88	7623	9836	
0550	-0.36	0.77	1.06	7049	9344	
0564	0.17	0.83	1.10	7131	9180	
0577	0.08	0.52	0.77	8443	9508	
0589	-0.46	1.13	1.50	5410	8525	
0597	-0.08	1.06	1.55	6475	8197	
0598	-0.07	0.84	1.27	8033	9262	
0609	-0.46	2.47	3.25	1951	5732	
0610	0.00	0.42	0.52	9508	10000	
0617	0.37	0.64	0.85	7787	9754	
0618	0.15	1.11	1.49	5862	8276	
0619	0.28	0.55	0.73	8500	9917	
0619	0.15	0.57	0.74	8361	9672	
MEAN:	0.07	0.82	1.11	7387	9190	

Temperature Month no. 3 All Hours		ME	MAE	RMSE	HR 1	HR 2
0505	0.37	0.52	0.72	8333	9917	
0509	0.76	0.88	1.06	6417	9417	
0517	0.50	0.77	0.94	7333	9667	
0536	0.50	0.64	0.81	7833	9833	
0550	-0.31	0.82	1.06	6500	9500	
0564	0.37	0.91	1.19	6500	9083	
0577	0.32	0.53	0.76	8417	9583	
0589	-0.09	1.10	1.40	5417	8250	
0597	0.15	0.93	1.29	6667	8750	
0598	0.61	1.10	1.31	5333	8833	
0609	-0.11	0.48	0.66	9036	9880	
0610	-0.05	0.53	0.71	8750	9833	
0617	0.24	0.68	0.90	7583	9750	
0618	-0.03	1.83	2.35	3894	5929	
0619	0.38	0.59	0.78	8220	9746	
0619	0.03	0.60	0.82	7750	9833	
MEAN:	0.23	0.81	1.05	7124	9238	

Temperature Month no. 4 All Hours		ME	MAE	RMSE	HR 1	HR 2
0505	0.39	0.63	0.87	8291	9744	
0509	0.79	1.05	1.31	5470	8889	
0517	0.06	0.79	0.98	7436	9744	
0536	0.67	0.85	1.07	6923	9744	
0550	0.00	0.71	0.97	7436	9402	
0564	0.32	0.99	1.29	5897	8974	
0577	0.40	0.70	0.94	8034	9316	
0589	0.18	1.21	1.51	5214	8291	
0597	0.29	0.66	0.81	8636	9545	
0598	1.01	1.26	1.48	4530	8120	
0609	-0.28	0.60	0.85	8085	9681	
0610	-0.06	0.66	0.93	8120	9316	
0617	0.56	0.78	1.00	7607	9316	
0618	0.12	1.24	1.62	4865	8108	
0619	0.83	0.91	1.24	6552	9138	
0619	-0.07	0.91	1.21	6667	8889	
MEAN:	0.33	0.87	1.13	6860	9138	

Temperature statistics for all times (00, 06, and 18UTC) for each month

Relative Humidity Month no. 1						
All Hours	ME	MAE	RMSE	HR 5	HR 10	
05050	-0.02	2.34	3.33	89.08	99.16	
05090	1.14	4.12	5.89	69.17	90.83	
05170	3.22	5.13	7.37	65.00	84.17	
05360	-0.12	2.92	4.53	79.17	94.17	
05500	-1.76	5.82	7.20	51.26	84.87	
05640	-0.08	6.64	8.21	47.50	82.50	
05770	0.14	2.72	4.13	85.00	97.50	
05910	6.99	8.62	11.94	48.74	64.71	
05985	2.14	4.77	6.99	68.33	84.17	
06096	-3.21	14.26	20.52	38.66	54.62	
06104	0.55	3.88	5.36	75.83	94.17	
06110	-2.38	4.78	6.44	64.17	90.00	
06124	0.38	5.46	7.50	59.09	83.64	
06160	-6.38	6.94	8.57	39.50	78.99	
MEAN:	0.04	5.60	7.71	62.89	84.53	

Relative Humidity Month no. 2						
All Hours	ME	MAE	RMSE	HR 5	HR 10	
05050	0.03	2.22	3.24	86.78	99.17	
05090	-0.49	3.16	3.93	84.43	98.36	
05170	1.47	3.20	4.49	76.23	95.08	
05360	-2.00	3.25	5.01	82.79	92.62	
05500	-6.37	6.63	7.82	36.07	85.25	
05640	-4.67	6.22	7.11	36.89	88.52	
05770	-0.62	2.70	3.55	84.43	99.18	
05910	2.54	6.51	8.64	51.64	77.87	
05985	2.90	4.79	6.44	60.66	86.89	
06096	0.61	9.05	12.12	40.24	60.98	
06104	-2.16	4.00	5.03	72.13	95.90	
06110	-2.06	3.68	4.63	77.05	98.36	
06124	-1.76	4.89	6.19	58.62	90.52	
06160	-6.62	6.81	7.60	31.67	81.67	
MEAN:	-1.37	4.79	6.13	62.83	89.31	

Relative Humidity Month no. 3						
All Hours	ME	MAE	RMSE	HR 5	HR 10	
05050	0.18	2.87	3.73	84.17	98.33	
05090	-2.30	5.05	6.42	58.33	85.00	
05170	-0.45	3.10	4.39	82.50	93.33	
05360	-2.13	3.74	5.60	72.50	92.50	
05500	-1.87	4.09	5.45	70.00	93.33	
05640	-2.20	5.39	6.40	50.83	87.50	
05770	-2.41	3.16	4.23	81.67	97.50	
05910	0.97	6.40	8.07	46.67	76.67	
05985	2.32	3.98	5.63	75.00	89.17	
06096	1.61	3.47	4.13	79.52	100.00	
06104	-0.02	4.00	5.56	71.67	90.83	
06110	-0.81	3.16	4.30	75.00	97.50	
06124	-0.71	6.83	9.14	52.21	77.88	
06160	-6.55	6.97	8.08	35.59	76.27	
MEAN:	-1.03	4.44	5.79	66.83	89.70	

Relative Humidity Month no. 4						
All Hours	ME	MAE	RMSE	HR 5	HR 10	
05050	0.15	4.16	6.68	76.92	92.31	
05090	-3.87	6.18	7.70	48.72	81.20	
05170	1.11	4.22	6.11	70.94	88.89	
05360	-2.26	4.11	5.98	73.50	91.45	
05500	-3.41	4.80	6.20	58.97	91.45	
05640	0.12	6.29	7.87	47.86	82.05	
05770	-1.02	3.26	4.20	81.20	96.58	
05910	0.27	4.98	6.04	54.55	86.36	
05985	2.32	5.88	8.71	58.97	82.91	
06096	0.24	4.15	5.60	69.15	93.62	
06104	-0.25	4.01	5.35	73.50	93.16	
06110	-3.00	4.22	5.75	65.81	93.16	
06124	0.78	5.89	7.72	53.15	84.68	
06160	-6.41	6.97	8.37	44.83	73.28	
MEAN:	-1.09	4.94	6.59	62.72	87.94	

Relative humidity statistics for all times (00, 06, 18d 18UTC) for each month

Temperature 1 months 1 Hours	Relative Humidity				
	ME	MAE	RMSE	HR 1	HR 2
096	-0.32	1.41	5.20	59.26	78.31
104	0.00	0.53	0.55	87.47	96.66
110	0.36	0.68	0.81	77.45	96.03
124	-0.06	1.29	3.06	53.11	77.56
160	0.46	0.67	0.93	78.22	95.35
169	0.08	0.69	0.86	75.78	95.20
050	0.32	0.50	0.50	85.32	98.74
090	0.51	0.77	1.00	72.23	94.78
170	0.27	0.72	0.82	77.04	97.29
360	0.48	0.69	0.77	77.45	98.12
300	-0.24	0.73	0.96	72.18	95.19
640	0.09	0.91	1.45	64.93	90.61
770	0.21	0.56	0.65	84.76	95.62
890	-0.01	1.13	2.11	55.74	83.72
910	-0.20	1.08	2.24	62.40	81.98
985	0.38	1.03	1.77	60.75	88.73
JM	0.15	0.84	1.48	71.51	91.49

Relative Humidity All months All Hours	Temperature				
	ME	MAE	RMSE	HR 5	HR 10
05050	0.08	2.89	19.86	84.28	97.27
05090	-1.36	4.61	37.38	65.34	88.94
05170	1.34	3.91	32.71	73.70	90.40
05360	-1.63	3.50	28.10	77.04	92.69
05500	-3.37	5.34	45.39	53.97	88.70
05640	-1.73	6.13	55.18	45.72	85.18
05770	-0.97	2.96	16.28	83.09	97.70
05910	3.30	7.04	90.58	49.35	73.89
05985	2.42	4.85	49.27	65.76	85.80
06096	-0.47	8.25	175.95	55.56	75.66
06104	-0.48	3.97	28.37	73.28	93.53
06110	-2.06	3.96	28.57	70.56	94.78
06124	-0.35	5.76	59.33	55.78	84.22
06160	-6.49	6.92	66.57	37.84	77.59
MEAN:	-0.84	5.01	52.40	63.66	87.60

Relative humidity and temperature statistics for all times (00, 06, 12 and 18 UTC) and all months

Appendix B

This appendix contains tables with detailed statistics of the verification of the OI-analysis field for each verifying station. The following parameters are used:

Month no. 1 April 21-May 20 1999
Month no. 2 May 21-June 20 1999
Month no. 3 June 21-July 20 1999
Month no. 4 July 21-August 19 1999

ME Mean Error, i.e. the sum of the difference between the analysed values and the observations, divided by the number of observations.
MAE Mean Absolute Error, i.e. the sum of the absolute difference between the analysed values and the observations, divided by the number of observations.
RMSE Root Mean Square Error, i.e. square root of the mean squared error.
HR 1 Hit Rate, i.e. the relative number of analysed value that are within +/- 1 degrees Celsius of the observed temperature.
HR 2 Hit Rate, i.e. the relative number of analysed value that are within +/- 2 degrees Celsius of the observed temperature.
HR 5 Hit Rate, i.e. the relative number of analysed value that are within +/- 5% of the observed relative humidity.
HR 10 Hit Rate, i.e. the relative number of analysed value that are within +/- 10% of the observed relative humidity.

All Hit Rates are given in percent hits.

ME, MAE and RMSE are in degree Celsius in tables showing temperature statistics and in percent humidity in tables showing relative humidity statistics.

Temperature Month no 1	ME	MAE	RMSE	HR 1	HR 2
00UTC					
05050	-0.09	0.88	1.25	6897	8966
05090	-0.52	1.08	1.35	5172	8966
05170	-0.48	1.15	1.45	6207	8621
05360	-0.21	0.62	0.79	8276	10000
05500	-0.29	1.10	1.35	5517	8966
05640	-0.75	0.88	1.22	6552	8966
05770	-0.02	1.06	1.44	5517	7586
05890	-0.67	1.13	1.52	6538	8077
05910	-0.35	1.24	1.67	5862	7586
05985	-0.12	0.65	0.83	8621	9655
06096	-0.66	0.99	1.25	6087	8696
06104	0.34	0.97	1.29	5517	8621
06110	0.38	1.01	1.27	5517	8621
06124	-0.21	0.99	1.30	5769	8846
06160	0.23	1.12	1.44	5517	8276
06169	-0.33	0.95	1.22	6552	8966
MEAN:	-0.24	0.99	1.29	6257	8713

Temperature Month no 1	ME	MAE	RMSE	HR 1	HR 2
06UTC					
05050	-0.35	1.01	1.17	5333	9333
05090	-0.45	0.95	1.24	6333	9000
05170	-0.21	0.95	1.21	5667	9667
05360	-0.41	0.88	1.18	7000	9000
05500	-1.05	1.18	1.57	5667	8000
05640	-0.49	1.09	1.43	6000	9000
05770	-0.37	0.97	1.24	6333	9333
05890	-0.57	1.10	1.48	6207	8276
05910	-0.58	0.95	1.34	6000	8333
05985	-0.05	0.61	0.81	7667	10000
06096	-0.58	0.92	1.20	5833	9167
06104	-0.45	0.98	1.35	6333	9000
06110	-0.08	1.02	1.28	6000	9000
06124	-1.02	1.38	1.76	4800	7600
06160	0.02	0.89	1.27	7667	8667
06169	-0.74	1.33	1.83	5333	8000
MEAN:	-0.46	1.01	1.34	6136	8836

Temperature Month no 1	ME	MAE	RMSE	HR 1	HR 2
12UTC					
05050	-0.16	0.86	1.08	6333	9667
05090	0.71	1.01	1.23	5000	8333
05170	0.36	0.94	1.08	5333	9667
05360	0.42	0.85	1.14	6667	9000
05500	-1.03	1.27	1.91	6333	8000
05640	-0.86	1.35	1.71	4333	8333
05770	-0.15	1.48	1.74	2667	7667
05890	-0.37	1.30	1.59	5333	7333
05910	-0.94	1.46	2.14	4667	7667
05985	0.18	0.81	1.14	7667	9000
06096	-0.72	1.06	1.50	6957	8261
06104	-0.73	1.01	1.45	6333	8333
06110	-0.84	1.18	1.64	5667	8667
06124	-1.08	1.90	2.51	3103	6897
06160	-0.41	1.06	1.70	7241	8621
06169	-2.92	2.93	3.30	6.67	3667
MEAN:	-0.53	1.28	1.68	5269	8069

Temperature Month no 1	ME	MAE	RMSE	HR 1	HR 2
18UTC					
05050	-0.02	0.56	0.71	8667	10000
05090	0.90	0.90	1.14	6667	9000
05170	0.56	0.88	1.11	6667	9000
05360	0.36	0.69	0.80	7333	10000
05500	0.00	0.70	1.03	8000	9667
05640	-0.73	1.14	1.48	5333	8667
05770	-0.36	0.69	1.15	8667	9333
05890	-0.44	0.79	1.01	7000	9333
05910	-0.70	1.00	1.54	7000	9000
05985	0.01	0.92	1.17	7000	9000
06096	0.45	0.69	0.87	8333	9167
06104	-0.44	0.79	1.13	7667	9000
06110	0.23	0.74	1.01	8000	9667
06124	-0.34	0.77	1.19	7241	9310
06160	0.15	0.88	1.10	7667	9000
06169	-1.73	1.77	2.37	3667	6667
MEAN:	-0.13	0.87	1.18	71.82	91.13

Temperature statistics for the 1st month at times 00, 06, 12 and 18UTC.

Temperature Month no. 2 00 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.18	0.94	1.15	51.61	93.55
05090	0.40	0.75	1.04	77.42	96.77
05170	0.52	0.98	1.21	51.61	90.32
05360	0.37	0.95	1.15	64.52	93.55
05500	0.29	1.26	1.46	41.94	80.65
05640	0.14	0.95	1.15	64.52	96.77
05770	0.26	1.08	1.32	45.16	90.32
05890	-0.13	1.17	1.42	50.00	83.33
05910	0.36	1.30	1.58	45.16	80.65
05985	-0.46	0.72	0.95	70.97	90.32
06096	-0.32	1.01	1.20	59.26	92.59
06104	0.40	0.94	1.25	64.52	83.87
06110	0.77	1.22	1.42	45.16	90.32
06124	0.66	1.13	1.55	65.52	82.76
06160	0.26	0.74	0.96	64.52	93.55
06169	-1.33	1.52	1.79	32.26	70.97
MEAN:	0.15	1.04	1.29	55.88	88.14

Temperature Month no. 2 06 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	-0.06	0.58	0.78	90.32	96.77
05090	0.31	0.51	0.64	93.55	100.00
05170	0.58	0.77	0.96	61.29	96.77
05360	0.13	0.56	0.67	90.32	100.00
05500	-0.34	0.60	0.80	80.65	96.77
05640	0.11	0.70	0.84	74.19	100.00
05770	-0.11	0.68	0.80	77.42	100.00
05890	-1.75	1.86	2.28	32.26	64.52
05910	-0.40	0.69	0.88	74.19	96.77
05985	0.10	0.72	1.00	74.19	93.55
06096	-0.36	0.85	1.27	70.37	88.89
06104	0.22	0.52	0.60	96.77	100.00
06110	0.80	0.90	1.20	61.29	90.32
06124	-0.84	1.22	1.56	48.28	79.31
06160	-0.02	0.80	1.01	64.52	96.77
06169	-1.01	1.14	1.52	58.06	83.87
MEAN:	-0.17	0.82	1.05	71.73	92.77

Temperature Month no. 2 12 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.37	1.06	1.68	63.33	90.00
05090	0.56	0.86	1.06	74.19	96.77
05170	0.52	1.35	1.79	54.84	80.65
05360	0.27	0.84	1.08	70.97	90.32
05500	-0.79	1.10	1.43	51.61	87.10
05640	0.22	0.97	1.27	58.06	87.10
05770	0.04	0.89	1.12	64.52	90.32
05890	-1.42	1.79	2.19	35.48	54.84
05910	0.22	0.94	1.19	61.29	93.55
05985	0.71	0.94	1.18	70.97	90.32
06096	-0.20	0.76	0.97	66.67	96.30
06104	-0.22	0.91	1.17	70.97	90.32
06110	0.52	0.85	1.00	61.29	96.77
06124	-0.39	1.18	1.54	60.00	76.67
06160	-0.02	0.89	1.11	70.00	93.33
06169	-3.13	3.13	3.61	6.45	25.81
MEAN:	-0.17	1.15	1.46	58.79	83.76

Temperature Month no. 2 18 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.26	0.77	0.97	72.41	96.55
05090	0.78	0.98	1.33	58.62	96.55
05170	0.89	0.99	1.20	58.62	86.21
05360	0.66	0.81	1.01	62.07	96.55
05500	-0.03	0.62	0.80	79.31	96.55
05640	0.27	0.81	0.93	79.31	93.10
05770	0.04	0.38	0.49	96.55	100.00
05890	-0.77	1.30	1.62	48.28	82.76
05910	0.42	0.70	0.88	72.41	100.00
05985	-0.06	0.88	1.21	65.52	89.66
06096	0.12	0.78	1.01	68.00	92.00
06104	0.02	0.54	0.79	86.21	96.55
06110	0.67	0.78	0.97	75.86	96.55
06124	-0.10	0.75	1.05	75.00	92.86
06160	0.17	0.69	0.90	75.00	96.43
06169	-2.56	2.58	3.09	13.79	41.38
MEAN:	0.05	0.90	1.14	67.94	90.86

Temperature statistics for the 2nd month at times 00, 06, 12 and 18 UTC.

Temperature Month no. 3 00 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.65	1.12	1.53	66.67	83.33
05090	-0.20	0.83	1.03	60.00	96.67
05170	0.73	1.06	1.33	56.67	86.67
05360	0.60	0.90	1.09	70.00	96.67
05500	0.63	0.91	1.23	60.00	83.33
05640	0.88	1.24	1.54	46.67	76.67
05770	1.30	1.47	1.86	50.00	66.67
05890	0.72	1.57	1.92	40.00	63.33
05910	0.63	1.08	1.35	63.33	90.00
05985	0.10	0.87	1.10	56.67	90.00
06096	-0.83	1.27	1.48	45.00	85.00
06104	0.40	1.11	1.36	56.67	83.33
06110	0.72	1.08	1.31	53.33	83.33
06124	1.28	1.38	1.73	44.44	77.78
06160	1.06	1.29	1.66	51.72	68.97
06169	0.44	0.76	0.91	70.00	96.67
MEAN:	0.57	1.12	1.40	55.70	83.03

Temperature Month no. 3 06 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.09	0.62	0.83	83.33	96.67
05090	0.08	0.55	0.69	90.00	100.00
05170	0.34	0.57	0.66	90.00	100.00
05360	0.40	0.64	0.75	90.00	100.00
05500	-0.29	0.64	0.83	76.67	96.67
05640	0.43	0.63	0.71	83.33	100.00
05770	0.22	0.62	0.72	80.00	100.00
05890	-0.68	1.37	1.77	43.33	80.00
05910	0.50	0.74	0.99	76.67	93.33
05985	0.26	0.65	0.79	76.67	96.67
06096	-0.29	0.55	0.68	90.00	100.00
06104	0.15	0.66	0.82	76.67	100.00
06110	0.58	0.69	0.89	80.00	96.67
06124	0.02	0.81	0.94	70.37	100.00
06160	0.40	0.80	0.95	63.33	100.00
06169	-0.02	0.83	0.95	66.67	100.00
MEAN:	0.14	0.71	0.87	77.31	97.50

Temperature Month no. 3 12 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.82	1.20	1.62	53.33	80.00
05090	0.98	1.19	1.38	43.33	86.67
05170	1.32	1.54	1.92	46.67	70.00
05360	0.74	1.27	1.60	50.00	83.33
05500	-0.45	1.42	1.69	33.33	80.00
05640	0.56	1.16	1.64	56.67	83.33
05770	0.74	1.04	1.47	70.00	80.00
05890	-0.79	1.76	2.17	36.67	60.00
05910	0.52	0.99	1.29	50.00	93.33
05985	0.61	0.96	1.23	63.33	86.67
06096	-0.21	1.14	1.58	63.64	72.73
06104	0.59	1.33	1.80	53.33	80.00
06110	0.50	1.11	1.53	63.33	80.00
06124	-0.10	1.23	1.62	50.00	80.00
06160	0.63	1.24	1.53	44.83	79.31
06169	-1.21	1.71	2.19	43.33	70.00
MEAN:	0.33	1.27	1.64	51.36	79.09

Temperature Month no. 3 18 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.55	0.99	1.26	63.33	93.33
05090	0.87	1.00	1.30	66.67	83.33
05170	0.85	1.01	1.22	60.00	86.67
05360	0.38	0.98	1.37	60.00	83.33
05500	0.14	1.09	1.44	53.33	83.33
05640	0.42	0.79	1.05	66.67	96.67
05770	0.87	1.02	1.25	53.33	93.33
05890	0.20	1.07	1.28	56.67	93.33
05910	0.69	1.11	1.41	46.67	93.33
05985	0.42	0.71	0.95	70.00	96.67
06096	0.09	0.58	0.75	80.95	100.00
06104	0.02	0.98	1.22	60.00	90.00
06110	0.43	0.86	1.05	60.00	93.33
06124	0.19	1.04	1.40	58.62	89.66
06160	0.41	0.93	1.20	60.00	93.33
06169	-0.68	1.12	1.38	60.00	80.00
MEAN:	0.36	0.96	1.22	61.01	90.60

Temperature statistics for the 3rd month at times 00, 06, 12 and 18 UTC.

Temperature Month no. 4 00 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.68	1.27	1.68	53.33	76.67
05090	0.01	0.91	1.18	80.00	90.00
05170	0.60	1.00	1.26	56.67	90.00
05360	0.80	1.11	1.51	50.00	80.00
05500	1.28	1.34	1.77	50.00	73.33
05640	1.02	1.11	1.45	53.33	80.00
05770	1.69	1.75	2.14	33.33	60.00
05890	1.55	2.15	2.48	20.00	53.33
05910	1.00	1.00	1.16	83.33	83.33
05985	0.73	1.11	1.50	56.67	83.33
06096	-0.03	0.88	1.16	70.83	91.67
06104	1.14	1.20	1.73	60.00	76.67
06110	1.45	1.48	1.83	46.67	66.67
06124	1.66	1.72	1.96	25.00	57.14
06160	1.53	1.55	1.99	41.38	68.97
06169	1.40	1.45	1.69	36.67	73.33
MEAN:	1.03	1.31	1.65	51.08	75.28

Temperature Month no. 4 06 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.29	0.84	1.09	65.52	96.55
05090	-0.32	0.85	1.05	65.52	93.10
05170	0.18	0.52	0.68	82.76	100.00
05360	0.46	0.74	0.92	75.86	96.55
05500	0.06	0.66	0.88	72.41	96.55
05640	-0.06	0.53	0.65	89.66	100.00
05770	-0.16	0.37	0.49	96.55	100.00
05890	-0.81	1.02	1.48	62.07	82.76
05910	0.21	0.50	0.57	100.00	100.00
05985	0.04	0.73	0.91	72.41	96.55
06096	-0.25	0.69	0.87	73.91	100.00
06104	0.47	0.77	0.97	79.31	93.10
06110	1.13	1.21	1.47	51.72	86.21
06124	-0.77	1.14	1.47	44.44	81.48
06160	0.98	1.14	1.36	55.17	82.76
06169	0.66	1.26	1.47	44.83	79.31
MEAN:	0.13	0.81	1.02	70.76	92.81

Temperature Month no. 4 12 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.91	1.33	1.61	44.83	82.76
05090	1.44	1.58	2.03	34.48	75.86
05170	0.20	1.02	1.22	55.17	89.66
05360	1.12	1.38	1.62	41.38	75.86
05500	0.11	0.98	1.25	51.72	89.66
05640	0.32	1.02	1.34	55.17	86.21
05770	0.39	0.90	1.22	72.41	93.10
05890	-0.25	1.56	1.78	31.03	72.41
05910	1.11	1.24	1.59	60.00	60.00
05985	0.30	1.16	1.39	51.72	82.76
06096	-0.23	0.87	1.19	64.00	88.00
06104	0.23	0.86	1.17	68.97	89.66
06110	0.77	1.03	1.32	55.17	82.76
06124	-0.08	1.12	1.30	46.43	85.71
06160	0.62	0.92	1.18	58.62	86.21
06169	-0.14	1.11	1.44	55.17	82.76
MEAN:	0.43	1.13	1.42	52.89	82.71

Temperature Month no. 4 18 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.89	1.13	1.48	51.72	79.31
05090	1.18	1.35	1.56	34.48	86.21
05170	1.20	1.41	1.72	55.17	75.86
05360	1.60	1.68	2.29	44.83	72.41
05500	0.36	0.68	0.87	75.86	96.55
05640	0.09	0.79	0.95	79.31	93.10
05770	0.54	0.94	1.22	62.07	86.21
05890	0.96	1.10	1.33	48.28	89.66
05910	0.16	0.60	0.80	80.00	100.00
05985	0.09	0.76	0.99	72.41	89.66
06096	0.23	0.56	0.66	95.45	100.00
06104	-0.10	1.16	1.52	51.72	89.66
06110	0.56	0.70	1.04	82.76	96.55
06124	0.15	1.00	1.20	60.71	89.29
06160	0.46	0.71	0.89	72.41	100.00
06169	0.24	1.30	1.53	37.93	82.76
MEAN:	0.54	0.99	1.25	62.82	89.20

Temperature statistics for the 4th month at times 00, 06, 12 and 18 UTC.

Relative Humidity						
Month no 1	ME	MAE	RMSE	HR 5	HR 10	
00UTC						
0500	-3.99	5.74	7.84	5862	7931	
0500	-0.91	4.61	6.95	7586	8276	
05170	1.51	6.17	8.50	6552	7931	
0530	-0.59	3.81	5.16	7586	9310	
0530	-2.84	3.95	4.99	6897	9655	
05640	-4.40	5.67	7.07	5172	8276	
0570	-4.66	6.38	9.26	6552	7931	
0590	-1.38	4.36	6.71	6897	8966	
0595	-2.93	5.95	8.78	6552	7931	
0606	-1.13	5.03	6.20	6522	8696	
06104	1.04	4.23	5.90	6552	8966	
06110	-3.94	5.29	7.65	6207	8621	
06124	-11.60	11.72	14.13	2308	4231	
06160	-8.11	8.11	10.83	51.72	6897	
MEAN:	-3.14	5.79	7.86	61.73	81.15	

Relative Humidity						
Month no 1	ME	MAE	RMSE	HR 5	HR 10	
06UTC						
0500	-0.60	4.83	6.69	7333	9000	
0500	-1.51	4.11	5.63	7000	9000	
05170	1.93	5.40	6.45	6333	9333	
0530	-0.12	4.08	5.43	7667	9333	
0530	1.92	4.14	5.11	7333	9000	
05640	-3.85	5.30	7.68	6000	8667	
0570	-0.46	5.08	6.59	7000	8667	
0590	1.53	4.57	6.79	7000	9000	
0595	0.47	3.51	5.07	6667	9333	
0606	2.48	5.08	6.57	6667	8750	
06104	0.79	4.28	5.65	6333	9000	
06110	0.72	4.86	6.31	6667	8667	
06124	-6.63	6.94	8.49	4800	7200	
06160	-4.59	5.52	8.01	5667	8333	
MEAN:	-0.56	4.84	6.46	6605	8806	

Relative Humidity						
Month no 1	ME	MAE	RMSE	HR 5	HR 10	
12 UTC						
0500	-2.52	6.70	8.19	4000	8333	
0500	-7.17	7.70	9.44	4333	6667	
05170	1.03	5.47	6.82	5333	8667	
0530	-3.06	5.45	6.85	6000	9000	
0530	2.73	6.73	8.59	5000	7333	
05640	4.87	8.32	10.60	3667	7000	
0570	3.57	6.23	8.54	5667	8000	
0590	11.53	13.03	15.89	1667	5000	
0595	0.03	6.76	9.12	4333	7333	
0606	2.07	6.52	8.56	4783	8261	
06104	6.40	9.58	11.38	3000	5333	
06110	4.43	7.13	9.18	5000	7333	
06124	-3.84	8.69	10.30	3448	5862	
06160	0.26	4.34	5.92	7241	9310	
MEAN:	1.45	7.33	9.24	4534	7388	

Relative Humidity						
Month no 1	ME	MAE	RMSE	HR 5	HR 10	
18UTC						
0500	-1.12	5.81	7.21	4667	8000	
0500	-5.46	8.27	10.82	3667	6667	
05170	0.56	7.15	9.96	5333	7667	
0530	-1.69	5.66	7.58	6667	8000	
0530	0.05	8.24	10.09	2667	7333	
05640	5.42	9.28	11.77	4000	6667	
0570	6.51	8.34	10.90	4667	6333	
0590	9.50	11.15	13.43	3000	4667	
0595	1.93	6.32	8.68	5000	8333	
0606	-1.14	5.88	7.31	5000	8750	
06104	6.92	9.15	11.64	2667	7000	
06110	0.15	5.77	7.80	5667	8333	
06124	-6.51	8.44	10.66	3448	6207	
06160	-0.59	6.27	9.72	5667	8333	
MEAN:	1.04	7.55	9.83	4437	7306	

Relative humidity statistics for the 1st month at tires00, 06, 12 and 18UTC.

Relative Humidity Month no. 2						
00 UTC	ME	MAE	RMSE	HR 5	HR 10	HR 10
05050	-0.59	2.30	3.22	87.10	100.00	100.00
05090	-1.84	3.22	4.14	77.42	96.77	96.77
05170	-0.50	2.94	4.26	87.10	96.77	96.77
05360	-0.18	2.41	3.07	90.32	100.00	100.00
05500	-9.21	9.21	10.67	16.13	64.52	64.52
05640	-8.00	8.35	9.50	29.03	64.52	64.52
05770	-4.12	4.66	5.79	51.61	93.55	93.55
05910	-5.14	6.42	7.99	48.39	74.19	74.19
05985	-2.81	5.48	6.96	48.39	87.10	87.10
06096	-1.98	3.96	5.01	62.96	92.59	92.59
06104	-3.08	4.15	5.33	70.97	93.55	93.55
06110	-6.43	7.56	8.76	32.26	74.19	74.19
06124	-18.84	18.84	19.69	0.00	6.90	6.90
06160	-8.10	8.10	9.31	25.81	70.97	70.97
MEAN:	-5.06	6.26	7.41	51.96	79.69	79.69

Relative Humidity Month no. 2						
06 UTC	ME	MAE	RMSE	HR 5	HR 10	HR 10
05050	0.13	3.65	4.74	77.42	96.77	96.77
05090	-2.50	4.46	5.41	58.06	90.32	90.32
05170	0.71	4.66	5.41	61.29	96.77	96.77
05360	-1.93	3.45	4.36	77.42	100.00	100.00
05500	-3.71	4.31	5.73	67.74	90.32	90.32
05640	-6.98	7.02	9.60	48.39	80.65	80.65
05770	0.23	3.72	4.38	64.52	100.00	100.00
05910	-1.90	4.75	6.28	67.74	87.10	87.10
05985	0.50	5.45	7.30	58.06	83.87	83.87
06096	4.29	5.37	7.52	66.67	77.78	77.78
06104	-3.33	4.76	6.04	58.06	90.32	90.32
06110	-1.34	3.93	4.39	83.87	100.00	100.00
06124	-11.07	11.36	13.20	20.69	44.83	44.83
06160	-5.01	5.35	6.43	48.39	90.32	90.32
MEAN:	-2.28	5.16	6.48	61.31	87.79	87.79

Relative Humidity Month no. 2						
12 UTC	ME	MAE	RMSE	HR 5	HR 10	HR 10
05050	-4.02	7.75	10.61	43.33	73.33	73.33
05090	-5.99	7.35	8.86	29.03	74.19	74.19
05170	1.32	7.63	10.24	45.16	77.42	77.42
05360	-4.62	6.68	8.79	51.61	70.97	70.97
05500	-7.29	8.68	11.36	45.16	64.52	64.52
05640	-3.29	6.12	7.88	54.84	80.65	80.65
05770	1.83	6.68	8.29	41.94	70.97	70.97
05910	5.90	9.08	10.72	32.26	48.39	48.39
05985	-0.95	5.54	6.80	58.06	90.32	90.32
06096	0.59	5.21	6.39	62.96	85.19	85.19
06104	4.25	8.45	10.60	48.39	58.06	58.06
06110	-1.79	7.14	8.46	48.39	70.97	70.97
06124	-9.13	9.58	11.55	30.00	53.33	53.33
06160	-0.47	4.84	6.01	66.67	90.00	90.00
MEAN:	-1.69	7.19	9.04	46.99	72.02	72.02

Relative Humidity Month no. 2						
18 UTC	ME	MAE	RMSE	HR 5	HR 10	HR 10
05050	-0.76	4.42	5.96	68.97	93.10	93.10
05090	-3.70	7.29	9.39	55.17	75.86	75.86
05170	1.93	6.44	8.39	51.72	72.41	72.41
05360	-2.64	5.98	7.88	55.17	82.76	82.76
05500	-3.67	5.66	7.39	48.28	82.76	82.76
05640	-1.94	5.69	7.62	58.62	82.76	82.76
05770	1.86	7.05	9.12	55.17	68.97	68.97
05910	5.51	8.89	11.84	37.93	72.41	72.41
05985	3.98	6.70	8.48	41.38	79.31	79.31
06096	0.63	6.04	7.70	60.00	72.00	72.00
06104	2.32	4.42	5.47	58.62	96.55	96.55
06110	-3.69	5.88	7.16	51.72	75.86	75.86
06124	-9.41	11.15	13.21	28.57	50.00	50.00
06160	0.10	6.51	8.35	50.00	75.00	75.00
MEAN:	-0.68	6.58	8.43	51.52	77.13	77.13

Relative humidity statistics for the 2nd month at times 00, 06, 12 and 18 UTC.

Relative Humidity Month no 3						
00UTC	ME	MAE	RMSE	HR 5	HR 10	
0500	-1.10	3.89	5.35	7667	9333	
0500	-0.45	3.06	3.92	9000	9667	
05170	1.25	2.86	4.43	8667	9333	
0530	-1.32	2.93	3.73	8667	9667	
0500	-6.69	7.60	8.99	3667	6667	
05640	-4.78	5.21	6.31	5333	8667	
0570	-6.36	6.67	9.37	5667	8000	
0590	-5.84	6.22	8.09	4333	7667	
0595	-2.18	4.56	5.50	6333	9333	
0606	0.67	4.48	5.63	6500	9500	
06104	-1.42	3.64	4.35	7667	10000	
06110	-3.38	4.53	5.86	6667	9000	
06124	-15.36	15.89	16.97	3.70	14.81	
06160	-10.05	10.05	11.28	13.79	55.17	
MEAN:	-4.07	5.83	7.13	5851	81.31	

Relative Humidity Month no 3						
06UTC	ME	MAE	RMSE	HR 5	HR 10	
0500	-0.69	4.35	5.88	7000	9000	
0500	0.29	5.00	6.72	7000	8667	
05170	3.05	4.69	5.56	6667	9667	
0530	-1.35	5.23	6.67	7000	8333	
0500	-1.30	5.17	6.50	5333	8333	
05640	-2.68	5.28	6.98	6000	8667	
0570	0.95	4.91	6.00	6000	9667	
0590	-0.16	4.58	5.90	6000	9000	
0595	2.03	3.97	4.79	6667	9667	
0606	5.49	6.73	7.98	4000	8500	
06104	-1.78	4.98	6.91	5667	8667	
06110	0.87	3.83	4.39	7333	10000	
06124	-7.08	8.91	10.14	2593	5926	
06160	-3.18	4.85	6.08	6000	9000	
MEAN:	-0.40	5.18	6.46	5947	87.92	

Relative Humidity Month no 3						
12 UTC	ME	MAE	RMSE	HR 5	HR 10	
0500	-0.80	7.57	9.90	4333	7667	
0500	-6.16	9.06	11.43	3333	6000	
05170	-0.18	8.91	10.75	3333	6333	
0530	-1.45	7.12	9.32	5333	7333	
0500	2.87	6.66	8.53	5333	7333	
05640	2.09	8.86	10.76	3667	6000	
0570	-0.91	8.15	10.77	4000	7667	
0590	5.15	8.00	9.52	3667	6667	
0595	5.31	7.16	9.01	4333	7000	
0606	4.98	8.00	10.49	3636	7273	
06104	3.26	9.31	11.53	4000	5333	
06110	2.14	7.81	9.84	3333	7333	
06124	-5.32	6.72	9.56	5333	7667	
06160	0.68	6.69	8.17	4828	6897	
MEAN:	0.83	7.86	9.97	4176	68.93	

Relative Humidity Month no 3						
18 UTC	ME	MAE	RMSE	HR 5	HR 10	
0500	-3.88	7.70	10.22	4667	7000	
0500	-8.56	10.13	13.64	3333	6667	
05170	-1.77	7.30	10.03	4333	7667	
0530	-5.25	9.99	13.79	4000	6667	
0500	2.44	6.36	8.07	5000	8333	
05640	0.80	6.95	9.45	5000	7667	
0570	-3.94	7.95	9.30	3000	8000	
0590	2.68	7.61	9.59	4333	6667	
0595	3.11	7.17	8.83	4000	7333	
0606	3.40	6.60	8.26	4762	8095	
06104	3.47	10.96	14.63	2667	5000	
06110	0.77	7.62	9.68	3000	8000	
06124	-6.94	8.66	11.49	3793	6897	
06160	-2.79	7.11	9.02	4000	7667	
MEAN:	-1.18	8.01	10.43	3992	72.61	

Relative humidity statistics for the 3rd month at times 00, 06, 12 and 18 UTC.

Relative Humidity Month no 4						
00UTC	ME	MAE	RMSE	HR 5	HR 10	
0500	-1.22	5.56	10.31	7000	9333	
0500	-1.77	4.91	6.40	6333	9000	
0510	0.12	5.26	7.04	6333	8000	
0530	-1.97	4.60	6.03	7000	9000	
0550	-6.51	7.37	9.13	3667	7667	
0560	-5.16	5.66	8.63	7000	8000	
0570	-6.79	7.79	11.61	6000	7000	
0590	-3.70	3.70	4.62	6667	10000	
0595	-5.06	6.56	9.93	5667	8333	
0606	-1.97	5.46	6.32	5000	9583	
0610	-2.83	4.81	6.11	6333	9000	
0610	-6.08	7.29	8.90	4333	6667	
0612	-17.94	17.94	19.13	000	1071	
0616	-11.40	11.47	13.19	1379	5172	
MEAN:	-5.16	7.03	9.10	51.94	77.02	

Relative Humidity Month no 4						
06UTC	ME	MAE	RMSE	HR 5	HR 10	
0500	-2.27	6.34	8.75	5517	7241	
0500	-2.48	6.17	8.38	5172	8276	
0510	-0.59	5.30	8.02	6552	8966	
0530	-2.08	4.59	5.79	6897	8621	
0550	-3.34	5.08	6.88	5862	8966	
0560	-4.11	5.25	6.95	5862	8621	
0570	1.56	4.97	6.15	5862	8966	
0590	-2.63	3.20	3.80	6667	10000	
0595	1.43	5.43	7.31	6207	8966	
0606	-0.25	5.87	7.31	4783	8696	
0610	-4.27	5.57	7.17	6552	7931	
0610	-2.33	5.67	8.27	6897	8276	
0612	-8.25	9.73	10.92	1481	5926	
0616	-6.33	7.69	9.56	3793	7586	
MEAN:	-2.57	5.77	7.52	55.79	83.60	

Relative Humidity Month no 4						
12UTC	ME	MAE	RMSE	HR 5	HR 10	
0500	-4.49	11.55	13.73	1724	4483	
0500	-9.49	11.89	14.75	2759	5172	
0510	4.85	9.81	13.14	4828	6552	
0530	-5.39	9.73	12.11	3103	5517	
0550	-1.47	6.71	8.03	4138	7931	
0560	1.77	6.43	7.83	4138	7586	
0570	2.16	8.93	10.96	3103	6897	
0590	7.46	8.30	9.60	4000	6000	
0595	9.74	11.79	14.06	1724	5517	
0606	-0.10	6.82	9.39	4800	7600	
0610	3.89	8.66	11.56	4828	6897	
0610	-1.10	10.08	12.34	3103	5862	
0612	-3.85	8.31	10.20	3214	7857	
0616	0.76	8.82	10.85	2759	6207	
MEAN:	0.34	9.13	11.33	3444	6434	

Relative Humidity Month no 4						
18UTC	ME	MAE	RMSE	HR 5	HR 10	
0500	-3.00	10.55	14.28	3793	6207	
0500	-7.06	9.83	12.95	3103	6207	
0510	-0.44	9.38	12.08	3448	6552	
0530	-7.34	10.70	14.06	3793	5862	
0550	-0.46	6.56	8.89	6207	7241	
0560	3.20	6.89	9.25	5172	7586	
0570	1.96	7.00	10.24	5172	7586	
0590	7.62	8.50	12.50	6000	6000	
0595	4.30	7.86	9.63	3103	7241	
0606	-2.88	8.11	10.06	3636	6818	
0610	3.47	8.89	12.14	3793	6897	
0610	-3.17	7.60	10.00	4483	7931	
0612	-5.63	9.14	10.96	3929	5000	
0616	1.11	9.43	11.76	2759	6207	
MEAN:	-0.59	8.60	11.34	41.71	66.67	

Relative humidity statistics for the 4th month at times 00, 06, 12 and 18UTC.

Temperature All Months 00 UTC		ME	MAE	RMSE	HR 1	HR 2
05050	0.36	1.05	1.42	60.00	85.83	
05090	-0.07	0.89	1.16	67.50	93.33	
05170	0.35	1.05	1.31	56.67	88.33	
05360	0.40	0.90	1.16	66.67	92.50	
05500	0.48	1.15	1.47	51.67	81.67	
05640	0.33	1.04	1.35	57.50	85.83	
05770	0.81	1.34	1.72	45.83	73.33	
05890	0.40	1.52	1.89	43.10	69.83	
05910	0.27	1.19	1.52	57.29	82.29	
05985	0.06	0.84	1.13	67.50	90.00	
06096	-0.44	1.03	1.27	59.57	89.36	
06104	0.57	1.06	1.42	59.17	82.50	
06110	0.84	1.20	1.47	50.00	81.67	
06124	0.86	1.31	1.65	48.18	76.36	
06160	0.76	1.17	1.55	53.39	78.81	
06169	0.04	1.17	1.45	50.83	82.50	
MEAN:	0.38	1.12	1.43	55.93	83.38	

Temperature All Months 06 UTC		ME	MAE	RMSE	HR 1	HR 2
05050	-0.01	0.76	0.98	73.33	95.83	
05090	-0.09	0.71	0.93	78.33	95.83	
05170	0.22	0.70	0.91	72.50	98.33	
05360	0.14	0.70	0.90	81.67	96.67	
05500	-0.41	0.77	1.07	71.67	92.50	
05640	0.00	0.74	0.96	76.67	97.50	
05770	-0.10	0.66	0.86	79.17	98.33	
05890	-0.96	1.35	1.79	49.58	77.31	
05910	-0.14	0.78	1.06	72.16	91.75	
05985	0.09	0.68	0.88	75.00	96.67	
06096	-0.37	0.76	1.06	72.34	94.68	
06104	0.10	0.73	0.97	79.17	95.83	
06110	0.61	0.95	1.23	63.33	90.83	
06124	-0.65	1.14	1.46	52.78	84.26	
06160	0.33	0.91	1.15	65.00	91.67	
06169	-0.29	1.14	1.48	55.83	85.83	
MEAN:	-0.10	0.84	1.11	69.91	92.74	

Temperature All Months 12 UTC		ME	MAE	RMSE	HR 1	HR 2
05050	0.48	1.11	1.52	56.30	87.39	
05090	0.91	1.15	1.46	50.83	85.83	
05170	0.60	1.22	1.55	52.50	84.17	
05360	0.63	1.08	1.38	57.50	85.00	
05500	-0.55	1.19	1.59	50.00	84.17	
05640	0.06	1.12	1.50	53.33	85.00	
05770	0.25	1.08	1.41	58.33	85.00	
05890	-0.72	1.60	1.95	39.17	65.00	
05910	0.00	1.13	1.59	53.12	86.46	
05985	0.45	0.96	1.24	65.83	87.50	
06096	-0.33	0.94	1.31	65.98	85.57	
06104	-0.04	1.03	1.42	64.17	85.83	
06110	0.24	1.04	1.39	59.17	86.67	
06124	-0.41	1.36	1.80	47.01	77.78	
06160	0.20	1.03	1.40	61.54	86.32	
06169	-1.88	2.24	2.79	27.50	53.33	
MEAN:	-0.01	1.21	1.58	53.89	81.94	

Temperature All Months 18 UTC		ME	MAE	RMSE	HR 1	HR 2
05050	0.42	0.86	1.14	68.64	92.37	
05090	0.93	1.06	1.34	56.78	88.98	
05170	0.87	1.07	1.33	60.17	84.75	
05360	0.74	1.04	1.48	60.17	88.14	
05500	0.12	0.77	1.07	72.03	93.22	
05640	0.01	0.88	1.13	69.49	92.37	
05770	0.27	0.76	1.08	74.58	93.22	
05890	-0.02	1.06	1.33	55.93	89.83	
05910	0.13	0.92	1.29	63.83	94.68	
05985	0.12	0.82	1.08	69.49	91.53	
06096	0.23	0.66	0.84	81.52	95.65	
06104	-0.13	0.87	1.20	68.64	91.53	
06110	0.47	0.77	1.02	74.58	95.76	
06124	-0.02	0.89	1.22	66.67	91.23	
06160	0.30	0.80	1.04	70.94	94.87	
06169	-1.18	1.69	2.20	37.29	67.80	
MEAN:	0.20	0.93	1.24	65.67	90.37	

Temperature statistics for all months at times 00, 06, 12 and 18 UTC

Relative Humidity All Months						
	ME	MAE	RMSE	HR 5	HR 10	
00UTC						
06096	-1,70	4,34	7,16	7,333	9,167	
06104	-1,25	3,94	5,50	7,667	9,167	
06110	0,58	4,28	6,28	7,583	8,750	
06124	-1,01	3,42	4,63	8,083	9,500	
06160	-6,37	7,08	8,74	3,917	7,583	
05050	-5,61	6,24	8,00	5,083	7,833	
05090	-5,48	6,36	9,22	5,833	8,083	
05170	-4,14	5,56	7,48	5,417	8,125	
05360	-3,25	5,63	7,96	5,833	8,583	
05500	-1,21	4,72	5,79	6,064	9,255	
05640	-1,61	4,21	5,46	6,917	9,333	
05770	-4,98	6,19	7,90	5,083	7,917	
05910	-16,05	16,20	17,70	6,36	18,18	
05985	-9,39	9,41	11,21	2,627	6,186	
MEAN:	-4,39	6,26	8,07	5,577	7,950	

Relative Humidity All Months						
	ME	MAE	RMSE	HR 5	HR 10	
06UTC						
06096	-0,84	4,77	6,64	6,917	8,750	
06104	-1,55	4,92	6,61	6,250	8,750	
06110	1,29	5,01	6,42	6,417	9,417	
06124	-1,37	4,33	5,61	7,333	9,083	
06160	-1,61	4,67	6,09	6,333	8,833	
05050	-4,43	5,73	7,90	5,667	8,500	
05090	0,56	4,66	5,83	6,333	9,333	
05170	-0,35	4,55	6,21	6,598	8,969	
05360	1,10	4,59	6,23	6,333	9,083	
05500	2,97	5,70	7,34	5,638	8,404	
05640	-2,14	4,89	6,46	6,083	8,667	
05770	-0,51	4,56	6,02	7,333	9,250	
05910	-8,34	9,32	10,91	2,685	5,833	
05985	-4,77	5,83	7,62	5,083	8,500	
MEAN:	-1,43	5,25	6,85	6,072	8,670	

Relative Humidity All Months						
	ME	MAE	RMSE	HR 5	HR 10	
12UTC						
05050	-2,95	8,37	10,77	3,613	6,975	
05090	-7,17	8,96	11,30	3,333	6,333	
05170	1,73	7,94	10,46	4,500	7,333	
05360	-3,62	7,22	9,42	4,917	7,250	
05500	-0,84	7,21	9,25	4,750	7,250	
05640	1,32	7,43	9,37	4,250	7,167	
05770	1,66	7,48	9,69	4,250	7,417	
05910	7,50	9,93	12,21	2,917	5,521	
05985	3,45	7,76	10,04	4,083	7,250	
06096	1,76	6,56	8,74	4,948	7,938	
06104	4,46	9,00	11,26	4,167	5,833	
06110	0,91	8,01	10,03	4,083	6,917	
06124	-5,58	8,32	10,43	3,761	6,667	
06160	0,30	6,16	7,98	5,385	7,863	
MEAN:	0,21	7,88	10,07	4,211	6,980	

Relative Humidity All Months						
	ME	MAE	RMSE	HR 5	HR 10	
18UTC						
05050	-2,19	7,11	9,93	5,000	7,627	
05090	-6,21	8,89	11,83	3,898	6,780	
05170	0,06	7,56	10,20	4,576	7,288	
05360	-4,22	8,08	11,26	5,000	7,203	
05500	-0,38	6,71	8,68	4,661	7,797	
05640	1,89	7,22	9,66	5,000	7,542	
05770	1,59	7,59	9,92	4,576	7,203	
05910	5,99	9,18	11,77	3,830	6,170	
05985	3,32	7,01	8,91	4,068	7,712	
06096	-0,04	6,62	8,35	4,891	7,717	
06104	4,07	8,38	11,51	3,729	7,119	
06110	-1,45	6,72	8,75	4,576	7,966	
06124	-7,12	9,33	11,61	3,509	5,789	
06160	-0,57	7,33	9,80	4,359	7,436	
MEAN:	-0,38	7,69	10,15	4,405	7,239	

Relative humidity statistics for all months at times 00, 06, 12 and 18 UTC.

Temperature Month no. 1 All Hours		ME	MAE	RMSE	HR 1	HR 2
05050		-0.16	0.83	1.07	68.07	94.96
05090		0.16	0.99	1.24	57.98	88.24
05170		0.06	0.98	1.22	59.66	92.44
05360		0.04	0.76	0.99	73.11	94.96
05500		-0.59	1.06	1.50	63.87	86.55
05640		-0.71	1.11	1.47	55.46	87.39
05770		-0.23	1.05	1.41	57.98	84.87
05890		-0.51	1.08	1.41	62.61	82.61
05910		-0.64	1.16	1.70	58.82	81.51
05985		0.00	0.75	1.00	77.31	94.12
06096		-0.37	0.91	1.22	68.09	88.30
06104		-0.33	0.94	1.31	64.71	87.39
06110		-0.08	0.99	1.32	63.03	89.92
06124		-0.66	1.26	1.78	52.29	81.65
06160		0.00	0.99	1.39	70.34	86.44
06169		-1.44	1.75	2.32	40.34	68.07
MEAN:		-0.34	1.04	1.40	62.10	86.84

Temperature Month no. 2 All Hours		ME	MAE	RMSE	HR 1	HR 2
05050		0.18	0.84	1.19	69.42	94.21
05090		0.51	0.77	1.04	76.23	97.54
05170		0.62	1.02	1.33	56.56	88.52
05360		0.36	0.79	0.99	72.13	95.08
05500		-0.22	0.90	1.17	63.11	90.16
05640		0.18	0.86	1.06	68.85	94.26
05770		0.06	0.76	0.99	70.49	95.08
05890		-1.03	1.54	1.92	41.32	71.07
05910		0.14	0.91	1.17	63.11	92.62
05985		0.08	0.81	1.09	70.49	90.98
06096		-0.20	0.85	1.12	66.04	92.45
06104		0.11	0.73	0.99	79.51	92.62
06110		0.69	0.94	1.17	60.66	93.44
06124		-0.17	1.07	1.44	62.07	82.76
06160		0.10	0.78	1.00	68.33	95.00
06169		-2.00	2.08	2.64	27.87	55.74
MEAN:		-0.04	0.98	1.27	63.51	88.85

Temperature Month no. 3 All Hours		ME	MAE	RMSE	HR 1	HR 2
05050		0.53	0.98	1.35	66.67	88.33
05090		0.43	0.89	1.13	65.00	91.67
05170		0.81	1.04	1.36	63.33	85.83
05360		0.53	0.95	1.24	67.50	90.83
05500		0.01	1.01	1.34	55.83	85.83
05640		0.57	0.95	1.29	63.33	89.17
05770		0.78	1.04	1.39	63.33	85.00
05890		-0.14	1.44	1.81	44.17	74.17
05910		0.59	0.98	1.27	59.17	92.50
05985		0.35	0.80	1.03	66.67	92.50
06096		-0.30	0.89	1.20	69.88	89.16
06104		0.29	1.02	1.35	61.67	88.33
06110		0.56	0.93	1.22	64.17	88.33
06124		0.33	1.12	1.46	55.75	86.73
06160		0.62	1.06	1.36	55.08	85.59
06169		-0.37	1.11	1.45	60.00	86.67
MEAN:		0.35	1.01	1.33	61.35	87.54

Temperature Month no. 4 All Hours		ME	MAE	RMSE	HR 1	HR 2
05050		0.69	1.14	1.48	53.85	83.76
05090		0.57	1.17	1.50	53.85	86.32
05170		0.55	0.99	1.27	62.39	88.89
05360		0.99	1.23	1.66	52.99	81.20
05500		0.46	0.92	1.25	62.39	88.89
05640		0.35	0.86	1.15	69.23	89.74
05770		0.62	1.00	1.41	65.81	84.62
05890		0.37	1.46	1.83	40.17	74.36
05910		0.62	0.83	1.08	81.82	86.36
05985		0.29	0.94	1.22	63.25	88.03
06096		-0.07	0.76	1.00	75.53	94.68
06104		0.44	1.00	1.38	64.96	87.18
06110		0.98	1.11	1.45	58.97	82.91
06124		0.25	1.24	1.51	44.14	78.38
06160		0.90	1.08	1.41	56.90	84.48
06169		0.55	1.28	1.54	43.59	79.49
MEAN:		0.53	1.06	1.38	59.37	84.96

Temperature statistics for all times (00, 06, and 18UTC) for each month

Relative Humidity Month no. 1						
All Hours	ME	MAE	RMSE	HR 5	HR 10	
05050	-0.02	2.34	3.33	89.08	99.16	
05090	1.14	4.12	5.89	69.17	90.83	
05170	3.22	5.13	7.37	65.00	84.17	
05360	-0.12	2.92	4.53	79.17	94.17	
05500	-1.76	5.82	7.20	51.26	84.87	
05640	-0.08	6.64	8.21	47.50	82.50	
05770	0.14	2.72	4.13	85.00	97.50	
05910	6.99	8.62	11.94	48.74	64.71	
05985	2.14	4.77	6.99	68.33	84.17	
06096	-3.21	14.26	20.52	38.66	54.62	
06104	0.55	3.88	5.36	75.83	94.17	
06110	-2.38	4.78	6.44	64.17	90.00	
06124	0.38	5.46	7.50	59.09	83.64	
06160	-6.38	6.94	8.57	39.50	78.99	
MEAN:	0.04	5.60	7.71	62.89	84.53	

Relative Humidity Month no. 2						
All Hours	ME	MAE	RMSE	HR 5	HR 10	
05050	0.03	2.22	3.24	86.78	99.17	
05090	-0.49	3.16	3.93	84.43	98.36	
05170	1.47	3.20	4.49	76.23	95.08	
05360	-2.00	3.25	5.01	82.79	92.62	
05500	-6.37	6.63	7.82	36.07	85.25	
05640	-4.67	6.22	7.11	36.89	88.52	
05770	-0.62	2.70	3.55	84.43	99.18	
05910	2.54	6.51	8.64	51.64	77.87	
05985	2.90	4.79	6.44	60.66	86.89	
06096	0.61	9.05	12.12	40.24	60.98	
06104	-2.16	4.00	5.03	72.13	95.90	
06110	-2.06	3.68	4.63	77.05	98.36	
06124	-1.76	4.89	6.19	58.62	90.52	
06160	-6.62	6.81	7.60	31.67	81.67	
MEAN:	-1.37	4.79	6.13	62.83	89.31	

Relative Humidity Month no. 3						
All Hours	ME	MAE	RMSE	HR 5	HR 10	
05050	0.18	2.87	3.73	84.17	98.33	
05090	-2.30	5.05	6.42	58.33	85.00	
05170	-0.45	3.10	4.39	82.50	93.33	
05360	-2.13	3.74	5.60	72.50	92.50	
05500	-1.87	4.09	5.45	70.00	93.33	
05640	-2.20	5.39	6.40	50.83	87.50	
05770	-2.41	3.16	4.23	81.67	97.50	
05910	0.97	6.40	8.07	46.67	76.67	
05985	2.32	3.98	5.63	75.00	89.17	
06096	1.61	3.47	4.13	79.52	100.00	
06104	-0.02	4.00	5.56	71.67	90.83	
06110	-0.81	3.16	4.30	75.00	97.50	
06124	-0.71	6.83	9.14	52.21	77.88	
06160	-6.55	6.97	8.08	35.59	76.27	
MEAN:	-1.03	4.44	5.79	66.83	89.70	

Relative Humidity Month no. 4						
All Hours	ME	MAE	RMSE	HR 5	HR 10	
05050	0.15	4.16	6.68	76.92	92.31	
05090	-3.87	6.18	7.70	48.72	81.20	
05170	1.11	4.22	6.11	70.94	88.89	
05360	-2.26	4.11	5.98	73.50	91.45	
05500	-3.41	4.80	6.20	58.97	91.45	
05640	0.12	6.29	7.87	47.86	82.05	
05770	-1.02	3.26	4.20	81.20	96.58	
05910	0.27	4.98	6.04	54.55	86.36	
05985	2.32	5.88	8.71	58.97	82.91	
06096	0.24	4.15	5.60	69.15	93.62	
06104	-0.25	4.01	5.35	73.50	93.16	
06110	-3.00	4.22	5.75	65.81	93.16	
06124	0.78	5.89	7.72	53.15	84.68	
06160	-6.41	6.97	8.37	44.83	73.28	
MEAN:	-1.09	4.94	6.59	62.72	87.94	

Relative humidity statistics for all times (00, 06, 18d 18UTC) for each month

Temperature months hours	ME	MAE	RMSE	HR 1	HR 2
96	0.31	0.95	1.28	6457	9036
04	0.42	0.95	1.24	6339	9100
10	0.51	1.01	1.30	6046	8891
24	0.48	0.93	1.25	6653	9059
60	-0.09	0.97	1.32	6130	8787
69	0.10	0.95	1.25	6423	9017
90	0.31	0.96	1.31	6444	8745
90	-0.33	1.38	1.76	4693	7548
70	0.06	1.01	1.38	6162	8877
60	0.18	0.82	1.09	6946	9142
90	-0.23	0.85	1.14	6976	9125
90	0.13	0.92	1.27	6778	8891
70	0.54	0.99	1.29	6172	8870
90	-0.06	1.17	1.55	5367	8241
90	0.40	0.98	1.30	6271	8792
85	-0.83	1.56	2.06	4289	7238
MEAN:	0.12	1.02	1.36	6134	8710

Relative Humidity All months All Hours	ME	MAE	RMSE	HR 5	HR 10
05050	-1.92	6.14	8.79	5723	8134
05090	-4.04	6.67	9.23	5293	7762
05170	0.92	6.19	8.57	5774	8201
05360	-2.55	5.75	8.18	6339	8264
05500	-2.31	6.42	8.28	4916	7866
05640	-1.72	6.65	8.76	5000	7762
05770	-0.43	6.52	8.82	5251	8013
05910	2.23	7.29	9.75	4700	7206
05985	1.15	6.25	8.40	5084	8159
06096	0.88	5.90	7.65	5385	8329
06104	1.18	6.61	9.08	5230	7741
06110	-1.51	6.37	8.30	5272	8013
06124	-9.20	10.75	12.96	2673	5056
06160	-3.63	7.18	9.26	4364	7500
MEAN:	-1.50	6.76	9.00	5072	7715

Relative humidity and temperature statistics for all times (00, 06, 12 and 18 UTC) and all months

Appendix C

This appendix contains tables with detailed statistics of the verification of the HIRLAM-D field for each verifying station. The following parameters are used:

Month no. 1 April 21-May 20 1999
Month no. 2 May 21-June 20 1999
Month no. 3 June 21-July 20 1999
Month no. 4 July 21-August 19 1999

ME Mean Error, i.e. the sum of the difference between the analysed values and the observations, divided by the number of observations.
MAE Mean Absolute Error, i.e. the sum of the absolute difference between the analysed values and the observations, divided by the number of observations.
RMSE Root Mean Square Error, i.e. square root of the mean squared error.
HR 1 Hit Rate, i.e. the relative number of analysed value that are within +/- 1 degrees Celsius of the observed temperature.
HR 2 Hit Rate, i.e. the relative number of analysed value that are within +/- 2 degrees Celsius of the observed temperature.
HR 5 Hit Rate, i.e. the relative number of analysed value that are within +/- 5% of the observed relative humidity.
HR 10 Hit Rate, i.e. the relative number of analysed value that are within +/- 10% of the observed relative humidity.

All Hit Rates are given in percent hits.

ME, MAE and RMSE are in degree Celsius in tables showing temperature statistics and in percent humidity in tables showing relative humidity statistics.

Temperature Month no. 1. 00UTC	ME	MAE	RMSE	HR 1	HR 2
05050	-0.48	1.11	1.47	5172	8276
05090	-0.83	1.14	1.38	4483	8621
05170	-0.98	1.30	1.62	4138	8621
05360	-0.60	0.83	1.09	6897	9310
05500	-0.97	1.56	1.80	3103	6552
05640	-1.49	1.64	1.84	2414	6897
05770	-0.72	1.41	1.78	4138	7931
05890	-1.29	1.49	1.92	4231	6923
05910	-1.01	1.70	2.07	3103	7241
05985	-0.47	0.97	1.19	5517	8621
06096	-1.22	1.24	1.53	3913	8261
06104	-0.29	1.17	1.52	4483	8276
06110	-0.34	1.22	1.43	4828	8621
06124	-0.93	1.28	1.60	5385	7308
06160	-0.41	1.36	1.74	4483	8276
06169	-0.94	1.07	1.31	4828	8966
MEAN:	-0.81	1.28	1.58	4445	8044

Temperature Month no. 1 06UTC	ME	MAE	RMSE	HR 1	HR 2
05050	-1.11	1.40	1.64	4000	8000
05090	-1.08	1.34	1.65	4333	7667
05170	-1.11	1.43	1.76	4667	6667
05360	-1.20	1.43	1.68	3667	7667
05500	-2.02	2.09	2.36	1667	4333
05640	-1.54	1.70	2.00	4000	6000
05770	-1.33	1.38	1.71	4333	7667
05890	-1.35	1.40	1.88	5517	6897
05910	-1.46	1.51	1.87	3667	7000
05985	-0.48	0.97	1.14	5667	9333
06096	-1.42	1.62	1.83	2500	7083
06104	-1.36	1.44	1.88	4667	6667
06110	-1.04	1.43	1.71	4000	7667
06124	-2.02	2.02	2.37	2800	5200
06160	-0.89	1.21	1.60	6000	7667
06169	-1.69	1.78	2.37	4667	6667
MEAN:	-1.32	1.51	1.84	4134	7011

Temperature Month no. 1 12UTC	ME	MAE	RMSE	HR 1	HR 2
05050	-0.27	1.15	1.43	5333	7667
05090	0.90	1.34	1.60	5000	7000
05170	0.24	1.08	1.29	4667	9333
05360	0.50	1.07	1.48	6000	9000
05500	-1.12	1.55	2.18	5333	7333
05640	-1.00	1.60	2.03	3667	6667
05770	-0.24	1.56	2.01	3667	7000
05890	-0.47	1.38	1.66	4333	7667
05910	-1.12	1.60	2.42	4667	8000
05985	0.15	0.93	1.26	6333	8333
06096	-0.74	1.31	1.78	5217	7826
06104	-0.81	1.47	1.78	4000	7667
06110	-0.94	1.46	1.92	4333	7667
06124	-1.26	2.10	2.80	3103	6897
06160	-0.41	1.36	1.95	5517	7931
06169	-3.00	3.06	3.40	1000	2000
MEAN:	-0.60	1.50	1.94	4511	7374

Temperature Month no. 1 18UTC	ME	MAE	RMSE	HR 1	HR 2
05050	-0.16	0.68	0.85	7333	9667
05090	0.91	1.00	1.39	6000	8667
05170	0.35	0.92	1.11	6667	9667
05360	0.20	0.87	1.08	6667	9333
05500	-0.54	1.06	1.39	5000	9333
05640	-0.89	1.47	1.84	3667	7000
05770	-0.57	1.05	1.49	6333	9333
05890	-0.92	1.08	1.33	5667	8333
05910	-0.92	1.16	1.77	6000	8000
05985	-0.15	1.02	1.28	5667	8333
06096	-0.01	0.71	1.06	7500	9167
06104	-0.74	1.12	1.49	6667	8000
06110	-0.13	0.89	1.24	7000	9667
06124	-0.51	1.12	1.46	5517	8966
06160	-0.39	1.04	1.42	6000	8667
06169	-2.06	2.12	2.57	2333	5333
MEAN:	-0.41	1.08	1.42	5876	8592

Temperature statistics for the 1st month at times 00, 06, 12 and 18 UTC.

Temperature Month no 2	ME	MAE	RMSE	HR 1	HR 2
00UTC					
05050	-0.47	1.18	1.38	5806	8065
05090	-0.29	0.82	1.15	7097	9355
05170	-0.10	0.87	1.09	7097	9032
05360	-0.22	0.98	1.26	6452	9032
05500	-0.21	1.49	1.77	3548	7419
05640	-0.44	1.10	1.37	5484	8710
05770	-0.21	1.27	1.48	4839	7419
05890	-0.62	1.39	1.62	4000	7000
05910	0.00	1.40	1.64	4516	7097
05985	-0.93	1.09	1.31	5484	8710
06096	-0.87	1.16	1.40	4815	8519
06104	-0.14	1.20	1.52	3871	8710
06110	0.25	1.41	1.61	3226	8065
06124	0.20	1.32	1.69	4828	7241
06160	-0.39	1.09	1.28	4516	8710
06169	-1.97	1.98	2.24	2258	5161
MEAN:	-0.40	1.24	1.49	4865	8015

Temperature Month no 2	ME	MAE	RMSE	HR 1	HR 2
06UTC					
05050	-0.95	1.04	1.29	5484	9032
05090	-0.62	0.84	0.95	6774	10000
05170	-0.43	0.71	0.90	7419	9677
05360	-0.80	0.99	1.12	5484	9677
05500	-1.21	1.22	1.43	4839	8065
05640	-1.01	1.14	1.29	4839	9032
05770	-1.17	1.33	1.51	3548	8065
05890	-2.68	2.68	3.04	1290	3871
05910	-1.25	1.38	1.51	3226	7742
05985	-0.62	0.96	1.17	6452	9032
06096	-1.30	1.34	1.73	5185	7778
06104	-0.80	0.87	1.02	6452	9677
06110	-0.25	0.70	0.86	7419	10000
06124	-1.83	1.95	2.24	2414	5172
06160	-1.06	1.29	1.51	3548	8065
06169	-2.04	2.05	2.37	1935	4516
MEAN:	-1.13	1.28	1.50	4769	8088

Temperature Month no 2	ME	MAE	RMSE	HR 1	HR 2
12UTC					
05050	0.11	1.16	1.83	6333	9333
05090	0.36	0.99	1.22	5161	9032
05170	0.36	1.68	2.14	3871	7419
05360	0.05	0.94	1.22	6129	9355
05500	-0.85	1.38	1.65	4194	7742
05640	0.02	1.18	1.55	5484	8387
05770	-0.32	0.99	1.22	6129	8710
05890	-1.88	2.14	2.49	2258	4839
05910	-0.15	1.10	1.36	5161	9355
05985	0.38	0.86	1.19	5806	9355
06096	-0.41	0.90	1.12	5926	9259
06104	-0.32	1.23	1.57	5484	7742
06110	0.43	1.03	1.20	4194	9677
06124	-0.62	1.27	1.73	5000	7333
06160	-0.41	1.21	1.41	4000	8333
06169	-3.39	3.39	3.81	323	2258
MEAN:	-0.41	1.34	1.67	4716	8008

Temperature Month no 2	ME	MAE	RMSE	HR 1	HR 2
18UTC					
05050	-0.11	0.87	1.02	6552	9655
05090	0.17	0.84	1.23	6897	9310
05170	0.43	0.84	1.08	6552	8966
05360	0.04	0.84	1.01	6552	9655
05500	-0.59	0.98	1.17	6897	9310
05640	-0.06	0.96	1.18	5862	8621
05770	-0.25	0.80	0.96	6207	10000
05890	-1.20	1.56	1.89	3448	6552
05910	0.01	0.73	0.96	7586	9310
05985	-0.48	1.01	1.31	6897	8621
06096	-0.53	0.96	1.23	6400	8800
06104	-0.38	0.86	1.04	6552	9655
06110	0.26	0.80	1.02	6897	9655
06124	-0.47	1.02	1.34	6071	8571
06160	-0.30	1.11	1.31	5714	8571
06169	-2.91	2.93	3.35	1034	2759
MEAN:	-0.40	1.07	1.32	6007	8626

Temperature statistics for the 2nd month at times 00, 06, and 18UTC.

Temperature Month no. 3 00 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.27	1.54	1.84	30.00	73.33
05090	-0.53	0.83	1.09	73.33	93.33
05170	0.38	0.84	1.18	63.33	90.00
05360	0.26	0.85	1.09	66.67	93.33
05500	0.22	1.19	1.53	60.00	73.33
05640	0.59	1.42	1.67	36.67	60.00
05770	1.00	1.50	1.88	50.00	66.67
05890	0.50	1.68	1.97	33.33	56.67
05910	0.39	1.08	1.39	53.33	80.00
05985	-0.09	0.99	1.20	50.00	93.33
06096	-1.38	1.50	1.72	25.00	70.00
06104	0.09	1.35	1.53	33.33	80.00
06110	0.34	1.25	1.48	56.67	76.67
06124	0.98	1.37	1.69	44.44	74.07
06160	0.63	1.46	1.75	37.93	68.97
06169	0.06	0.55	0.67	90.00	100.00
MEAN:	0.23	1.21	1.48	50.25	78.11

Temperature Month no. 3 06 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	-0.11	0.68	0.85	76.67	96.67
05090	-0.21	0.57	0.78	76.67	100.00
05170	0.12	0.60	0.78	76.67	100.00
05360	0.01	0.72	0.89	80.00	96.67
05500	-0.80	0.99	1.24	56.67	90.00
05640	-0.29	0.64	0.79	73.33	100.00
05770	-0.39	0.73	0.91	73.33	100.00
05890	-1.30	1.68	2.04	33.33	70.00
05910	-0.21	0.82	1.04	73.33	93.33
05985	-0.10	0.63	0.82	90.00	96.67
06096	-0.81	0.96	1.17	50.00	90.00
06104	-0.37	0.87	1.07	60.00	96.67
06110	-0.06	0.65	0.83	76.67	100.00
06124	-0.81	0.97	1.25	66.67	85.19
06160	-0.16	0.84	1.06	70.00	90.00
06169	-0.35	0.69	0.92	73.33	93.33
MEAN:	-0.36	0.82	1.03	69.17	93.66

Temperature Month no. 3 12 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	1.05	1.40	1.82	43.33	76.67
05090	1.19	1.34	1.58	36.67	73.33
05170	1.66	1.88	2.28	26.67	56.67
05360	0.99	1.46	1.81	43.33	70.00
05500	-0.30	1.68	1.95	20.00	63.33
05640	0.94	1.49	1.92	36.67	73.33
05770	1.10	1.43	1.70	33.33	76.67
05890	-0.65	1.69	2.12	36.67	60.00
05910	0.81	1.23	1.54	50.00	86.67
05985	0.42	0.95	1.25	66.67	86.67
06096	0.01	1.18	1.61	59.09	77.27
06104	0.91	1.55	2.02	43.33	63.33
06110	0.75	1.46	1.86	46.67	70.00
06124	0.23	1.37	1.73	53.33	73.33
06160	0.68	1.51	1.85	41.38	75.86
06169	-0.95	1.43	1.85	53.33	66.67
MEAN:	0.55	1.44	1.81	43.15	71.86

Temperature Month no. 3 18 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.65	1.27	1.55	36.67	83.33
05090	0.92	1.15	1.51	46.67	80.00
05170	1.03	1.24	1.49	40.00	86.67
05360	0.44	1.24	1.57	53.33	80.00
05500	0.08	1.48	1.71	33.33	73.33
05640	0.60	1.04	1.33	53.33	83.33
05770	1.14	1.35	1.65	43.33	70.00
05890	0.26	1.01	1.25	56.67	83.33
05910	0.75	1.35	1.70	40.00	76.67
05985	0.20	0.72	0.91	80.00	96.67
06096	-0.16	0.77	0.96	66.67	100.00
06104	0.21	1.17	1.44	40.00	83.33
06110	0.48	1.15	1.32	40.00	93.33
06124	0.34	1.16	1.59	55.17	79.31
06160	0.34	0.93	1.21	66.67	93.33
06169	-0.55	1.19	1.50	46.67	73.33
MEAN:	0.42	1.14	1.42	49.91	83.50

Temperature statistics for the 3rd month at times 00, 06, 12 and 18 UTC.

Temperature Month no. 4 00 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.76	1.48	1.88	46.67	70.00
05090	-0.05	0.76	1.05	83.33	93.33
05170	0.50	0.98	1.31	63.33	83.33
05360	0.67	1.22	1.55	46.67	80.00
05500	1.03	1.46	1.83	40.00	80.00
05640	0.69	1.20	1.52	60.00	80.00
05770	1.42	1.84	2.18	30.00	56.67
05890	1.30	2.01	2.47	33.33	56.67
05910	-0.15	0.91	1.13	83.33	83.33
05985	0.46	1.32	1.62	46.67	76.67
06096	-0.44	0.91	1.15	58.33	91.67
06104	0.93	1.36	1.72	50.00	76.67
06110	1.16	1.49	1.80	33.33	80.00
06124	1.35	1.60	1.93	32.14	64.29
06160	1.36	1.68	2.04	37.93	65.52
06169	1.13	1.26	1.49	43.33	83.33
MEAN:	0.76	1.34	1.67	49.28	76.34

Temperature Month no. 4 06 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.36	1.07	1.27	58.62	93.10
05090	-0.23	0.93	1.16	58.62	93.10
05170	0.12	0.66	0.85	68.97	100.00
05360	0.55	0.76	0.95	68.97	96.55
05500	-0.12	0.71	0.87	79.31	96.55
05640	-0.42	0.72	0.87	72.41	100.00
05770	-0.36	0.73	0.89	68.97	100.00
05890	-1.00	1.41	1.86	48.28	79.31
05910	0.44	0.55	0.65	83.33	100.00
05985	-0.22	0.80	1.01	72.41	96.55
06096	-0.39	0.73	0.89	69.57	100.00
06104	0.41	0.77	1.02	68.97	89.66
06110	0.85	0.95	1.15	58.62	93.10
06124	-1.05	1.50	1.86	37.04	77.78
06160	0.53	0.88	1.09	68.97	93.10
06169	0.49	1.35	1.54	31.03	86.21
MEAN:	0.00	0.91	1.12	63.38	93.44

Temperature Month no. 4 12 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.98	1.49	1.78	31.03	75.86
05090	1.58	1.74	2.27	41.38	65.52
05170	0.35	1.21	1.49	41.38	75.86
05360	1.33	1.56	1.84	31.03	65.52
05500	0.57	1.42	1.61	34.48	72.41
05640	0.58	1.28	1.61	41.38	82.76
05770	0.41	1.16	1.50	55.17	82.76
05890	-0.20	1.58	1.87	31.03	72.41
05910	1.68	1.68	2.00	60.00	60.00
05985	0.18	1.09	1.33	48.28	89.66
06096	0.13	1.21	1.39	40.00	88.00
06104	0.52	1.25	1.53	44.83	82.76
06110	1.14	1.60	1.85	31.03	72.41
06124	0.17	1.21	1.54	53.57	75.00
06160	0.52	1.08	1.41	55.17	79.31
06169	-0.14	1.10	1.36	48.28	93.10
MEAN:	0.61	1.35	1.65	43.00	77.08

Temperature Month no. 4 18 UTC	ME	MAE	RMSE	HR 1	HR 2
05050	0.90	1.28	1.62	48.28	79.31
05090	1.38	1.56	1.88	31.03	68.97
05170	1.45	1.61	1.98	37.93	72.41
05360	1.92	2.03	2.59	27.59	62.07
05500	0.42	0.86	1.05	58.62	96.55
05640	0.34	1.01	1.31	55.17	86.21
05770	0.65	1.14	1.45	51.72	82.76
05890	0.82	1.01	1.40	58.62	75.86
05910	0.70	0.70	0.86	80.00	100.00
05985	0.04	0.91	1.19	58.62	93.10
06096	0.33	0.66	0.78	81.82	100.00
06104	0.34	1.23	1.70	51.72	79.31
06110	0.80	1.00	1.28	65.52	86.21
06124	0.34	0.83	1.21	78.57	85.71
06160	0.25	0.79	1.02	68.97	93.10
06169	0.32	1.17	1.50	58.62	82.76
MEAN:	0.69	1.11	1.43	57.05	84.02

Temperature statistics for the 4th month at times 00, 06, 12 and 18 UTC.

Relative Humidity		MAE		RMSE		HR 5		HR 10	
Month no 1	00UTC	ME	MAE	RMSE	HR 5	HR 10	ME	MAE	HR 10
0500	0.37	4.97	6.03	5862	8966	8966			
0500	0.32	4.74	7.23	7586	8276	8276			
0510	4.25	6.44	9.19	5862	8621	8621			
0530	0.39	3.61	4.69	8276	9655	9655			
0530	3.49	4.04	4.98	6897	9310	9310			
0540	1.46	3.21	5.58	8276	9310	9310			
0570	1.20	5.44	7.42	6552	7931	7931			
0590	4.89	6.87	9.25	6207	7241	7241			
0595	2.91	5.70	9.42	6897	8276	8276			
0606	3.35	4.81	5.70	5217	9565	9565			
0610	1.39	4.50	6.82	7241	8276	8276			
0610	1.39	4.19	5.79	6552	8966	8966			
06124	-5.97	7.36	9.31	4231	6154	6154			
06160	-2.06	3.58	5.39	7586	8966	8966			
MEAN:	1.44	4.96	6.91	6660	8537	8537			

Relative Humidity		MAE		RMSE		HR 5		HR 10	
Month no 1	06UTC	ME	MAE	RMSE	HR 5	HR 10	ME	MAE	HR 10
0500	-2.26	4.01	4.87	7000	9667	9667			
0500	-3.03	5.44	7.04	6000	9000	9000			
0510	-0.26	3.43	4.77	8000	9333	9333			
0530	-1.81	2.74	3.82	9000	9333	9333			
0530	0.10	4.37	5.76	7000	9333	9333			
0540	-4.86	6.21	7.31	5000	8000	8000			
0570	-0.59	3.00	4.17	8333	9667	9667			
0590	1.24	5.12	7.40	6667	8000	8000			
0595	-1.87	4.47	5.66	6667	9333	9333			
0606	0.79	3.77	5.24	7083	8750	8750			
0610	-1.20	5.34	6.71	5667	8667	8667			
0610	-1.21	3.69	4.66	7000	9667	9667			
06124	-7.80	8.79	10.43	3200	5200	5200			
06160	-4.01	5.24	6.36	6000	8667	8667			
MEAN:	-1.91	4.69	6.01	6615	8758	8758			

Relative Humidity		MAE		RMSE		HR 5		HR 10	
Month no 1	12 UTC	ME	MAE	RMSE	HR 5	HR 10	ME	MAE	HR 10
0500	-6.08	8.09	9.54	3000	7000	7000			
0500	-9.74	10.03	11.26	2333	4333	4333			
0510	-3.41	6.50	7.97	4667	8000	8000			
0530	-5.96	7.22	8.63	4333	7333	7333			
0530	-2.49	9.44	11.88	3333	6333	6333			
0540	-1.66	8.26	10.15	3667	5333	5333			
0570	-2.15	7.87	10.13	5000	6333	6333			
0590	4.54	8.62	10.99	4333	6667	6667			
0595	-7.70	9.18	11.57	4333	5667	5667			
0606	-1.55	5.74	7.53	6957	7391	7391			
0610	2.48	7.40	8.73	3667	7333	7333			
0610	-0.50	5.74	6.69	4333	9333	9333			
06124	-11.13	14.04	17.02	2759	3793	3793			
06160	-2.88	8.37	9.80	3103	6207	6207			
MEAN:	-3.45	8.32	10.14	3987	6504	6504			

Relative Humidity		MAE		RMSE		HR 5		HR 10	
Month no 1	18UTC	ME	MAE	RMSE	HR 5	HR 10	ME	MAE	HR 10
0500	-2.01	6.08	7.65	4333	7667	7667			
0500	-6.89	8.46	11.13	3667	6333	6333			
0510	-3.19	7.86	10.14	5000	6000	6000			
0530	-3.84	5.55	7.03	5333	7667	7667			
0530	-1.04	9.14	11.10	3333	6333	6333			
0540	2.92	7.94	10.46	5333	6667	6667			
0570	4.53	7.43	10.03	4667	6667	6667			
0590	5.67	8.52	10.41	3667	6333	6333			
0595	-2.18	7.15	8.80	4667	7667	7667			
0606	-3.80	5.65	7.95	6250	7917	7917			
0610	4.52	7.06	9.73	4667	7333	7333			
0610	-1.73	5.81	7.37	5333	8000	8000			
06124	-9.41	11.67	13.49	2414	3793	3793			
06160	0.23	5.21	6.81	5667	8667	8667			
MEAN:	-1.16	7.40	9.44	4595	6932	6932			

Relative humidity statistics for the 1st month at times 00, 06, 12 and 18 UTC.

Relative Humidity Month no 2						
00UTC	ME	MAE	RMSE	HR 5	HR 10	
0500	1.24	3.37	4.17	7742	9677	
0500	-1.05	2.59	3.53	8387	10000	
0510	1.16	3.93	5.20	7742	9355	
0530	0.76	2.76	3.11	9355	10000	
0550	-2.04	3.38	5.17	7742	8710	
0560	-2.63	3.81	5.51	7419	9032	
0570	1.92	4.37	5.22	7097	9032	
0590	2.16	5.46	6.88	6129	9032	
0595	2.22	4.22	5.34	6129	9355	
0606	3.47	5.00	6.10	6296	8889	
0610	-0.04	2.76	4.70	8387	9355	
0610	-0.74	3.14	4.14	7742	10000	
06124	-13.14	13.14	14.34	345	3103	
06160	-1.48	2.52	3.60	8065	9677	
MEAN:	-0.58	4.32	5.50	7041	8944	

Relative Humidity Month no 2						
06UTC	ME	MAE	RMSE	HR 5	HR 10	
0500	-2.27	3.75	5.33	7419	9355	
0500	-4.11	5.32	6.18	51.61	9355	
0510	-3.07	5.50	7.07	5484	7742	
0530	-4.01	4.61	5.58	6452	9032	
0550	-5.14	5.85	7.42	6129	7419	
0560	-8.60	8.60	10.32	3226	6452	
0570	-0.25	2.85	3.87	8065	10000	
0590	-1.75	4.12	5.69	7097	9032	
0595	-5.18	6.59	9.46	5806	8065	
0606	2.52	4.56	6.24	7037	8889	
0610	-5.80	6.61	7.73	3871	8387	
0610	-3.12	4.36	5.04	5806	9677	
06124	-11.88	11.88	13.56	1034	4483	
06160	-4.89	5.94	7.32	51.61	8065	
MEAN:	-4.11	5.75	7.20	5553	8282	

Relative Humidity Month no 2						
12UTC	ME	MAE	RMSE	HR 5	HR 10	
0500	-7.63	8.96	11.95	3667	5667	
0500	-9.05	9.76	11.18	1290	5806	
0510	-4.05	10.38	12.88	2581	5484	
0530	-7.93	8.58	10.68	2903	7097	
0550	-12.77	12.77	15.30	2258	4194	
0560	-9.31	11.57	13.38	1935	4516	
0570	-4.53	7.12	8.83	4194	7742	
0590	-0.76	6.98	8.68	4194	8065	
0595	-9.63	10.95	12.28	2258	4839	
0606	-4.23	5.96	7.02	4815	8889	
0610	-0.46	7.32	8.48	4194	6774	
0610	-6.94	7.87	9.46	3548	6129	
06124	-15.41	15.67	17.63	1333	2333	
06160	-6.96	9.88	11.62	3000	5000	
MEAN:	-7.12	9.55	11.38	3012	5895	

Relative Humidity Month no 2						
18UTC	ME	MAE	RMSE	HR 5	HR 10	
0500	-2.22	5.58	6.99	4828	8621	
0500	-6.24	8.76	10.73	41.38	5172	
0510	-2.79	9.05	10.77	2414	6207	
0530	-6.39	7.94	9.93	4483	6207	
0550	-6.67	8.28	10.82	41.38	7241	
0560	-6.92	8.40	10.54	3448	6207	
0570	-3.05	8.23	10.13	3448	6897	
0590	-0.51	7.01	8.80	4828	7241	
0595	-2.30	4.72	6.59	7241	8276	
0606	-2.26	5.52	7.03	6400	8000	
0610	-2.16	4.95	5.93	51.72	9655	
0610	-7.33	9.11	10.79	3793	5172	
06124	-14.62	15.48	17.27	1071	2143	
06160	-1.51	6.79	9.81	5357	8214	
MEAN:	-4.64	7.84	9.72	4340	6804	

Relative humidity statistics for the 2nd month at times 00, 06, and 18UTC.

Relative Humidity Month no 3						
00UTC	ME	MAE	RMSE	HR 5	HR 10	
0500	1.36	3.53	5.59	8000	9000	
0500	0.90	2.78	3.75	8667	9667	
0510	3.24	4.33	6.02	7667	9333	
0530	0.08	3.33	4.22	8667	9667	
0530	-2.61	4.91	6.45	6000	9000	
0540	-0.97	3.88	4.76	7000	10000	
0570	-1.30	4.98	6.50	6000	9000	
0590	-0.46	4.04	5.18	7667	9000	
0595	2.78	5.37	6.25	5333	9333	
0606	5.91	6.16	7.29	5500	9000	
0610	0.92	1.97	2.62	9000	10000	
0610	0.01	2.91	3.42	8333	10000	
06124	-11.97	11.97	13.15	7.41	4074	
06160	-3.52	3.87	5.74	6897	8621	
MEAN:	-0.40	4.57	5.78	6819	8978	

Relative Humidity Month no 3						
06UTC	ME	MAE	RMSE	HR 5	HR 10	
0500	-3.99	5.64	7.35	5333	8000	
0500	-2.15	5.14	6.59	6333	8333	
0510	-2.92	4.48	5.49	6333	9333	
0530	-4.23	5.45	7.13	5333	8333	
0530	-5.44	7.23	9.00	5333	7000	
0540	-7.17	7.77	9.45	4000	6667	
0570	-2.79	4.70	5.77	6333	8667	
0590	-3.32	6.53	7.79	4333	6667	
0595	-4.11	5.84	7.73	5333	7667	
0606	0.95	4.23	5.65	6000	9000	
0610	-5.82	6.59	7.66	4000	7667	
0610	-3.06	3.75	4.59	7333	10000	
06124	-11.19	12.88	14.31	14.81	2963	
06160	-5.85	7.03	9.19	4667	7667	
MEAN:	-4.36	6.23	7.69	51.53	77.12	

Relative Humidity Month no 3						
12UTC	ME	MAE	RMSE	HR 5	HR 10	
0500	-8.40	9.46	12.12	3667	6333	
0500	-13.07	13.97	15.73	1333	3333	
0510	-11.74	12.75	14.79	2000	4333	
0530	-9.99	11.66	14.78	2667	5667	
0530	-5.46	8.51	10.39	3333	6333	
0540	-8.07	10.40	12.96	2667	5333	
0570	-10.96	11.85	13.60	1333	4333	
0590	-5.26	7.06	8.82	4000	7667	
0595	-4.64	6.86	8.55	4000	8000	
0606	-4.60	7.64	9.00	2727	7273	
0610	-7.01	10.02	12.59	3333	6000	
0610	-6.83	8.59	10.43	4000	6000	
06124	-15.36	15.36	17.60	6.67	3333	
06160	-7.51	10.15	12.89	3448	5862	
MEAN:	-8.49	10.31	12.45	2798	5700	

Relative Humidity Month no 3						
18UTC	ME	MAE	RMSE	HR 5	HR 10	
0500	-7.82	10.46	12.48	2000	6000	
0500	-12.26	12.45	15.48	1667	5333	
0510	-8.68	9.52	12.37	3333	6000	
0530	-9.98	11.73	16.03	3333	5667	
0530	-4.59	9.66	12.24	4000	6000	
0540	-6.65	9.56	11.53	3333	6000	
0570	-10.50	11.74	13.55	1667	5000	
0590	-5.31	9.08	11.92	3667	6000	
0595	-2.79	7.23	8.91	4000	7667	
0606	-2.69	6.43	7.69	4286	7619	
0610	-3.31	9.41	13.37	4333	7333	
0610	-6.72	9.47	10.89	1667	6333	
06124	-15.75	15.84	18.50	6.90	3103	
06160	-6.58	8.18	11.72	5000	7667	
MEAN:	-7.40	10.05	12.62	3070	61.23	

Relative humidity statistics for the 3rd month at times 00, 06, 12 and 18 UTC.

Relative Humidity Month no. 4						
00 UTC	ME	MAE	RMSE	HR 5	HR 10	
05050	0.61	5.03	10.34	83.33	86.67	
05090	-1.40	5.20	6.85	56.67	86.67	
05170	2.53	5.86	7.65	56.67	83.33	
05360	-1.54	4.97	6.25	66.67	90.00	
05500	0.13	3.78	5.00	66.67	93.33	
05640	0.47	3.97	5.07	83.33	93.33	
05770	-0.21	5.66	8.00	70.00	86.67	
05910	0.17	4.40	5.40	66.67	83.33	
05985	0.84	5.72	7.41	63.33	90.00	
06096	3.55	4.93	6.11	58.33	91.67	
06104	0.08	3.30	4.20	83.33	96.67	
06110	-0.74	4.35	5.45	63.33	96.67	
06124	-1.201	12.01	13.52	7.14	39.29	
06160	-4.71	4.88	7.59	65.52	79.31	
MEAN:	-0.87	5.29	7.06	63.64	85.49	

Relative Humidity Month no. 4						
06 UTC	ME	MAE	RMSE	HR 5	HR 10	
05050	-3.89	6.54	8.49	55.17	79.31	
05090	-4.34	6.38	8.39	44.83	82.76	
05170	-2.07	5.24	7.47	68.97	79.31	
05360	-3.56	5.29	6.91	58.62	82.76	
05500	-2.64	4.64	5.84	65.52	86.21	
05640	-4.56	5.28	6.92	55.17	86.21	
05770	1.76	4.68	6.25	72.41	89.66	
05910	-7.27	7.40	8.37	33.33	83.33	
05985	-2.12	6.59	8.99	55.17	75.86	
06096	0.69	5.47	6.97	47.83	82.61	
06104	-5.18	5.47	7.52	55.17	82.76	
06110	-2.37	3.74	5.75	79.31	86.21	
06124	-8.93	9.92	11.53	25.93	48.15	
06160	-4.46	7.23	8.58	31.03	86.21	
MEAN:	-3.50	5.99	7.71	53.46	80.81	

Relative Humidity Month no. 4						
12 UTC	ME	MAE	RMSE	HR 5	HR 10	
05050	-9.63	14.51	16.44	10.34	34.48	
05090	-14.80	16.02	18.79	13.79	34.48	
05170	-2.76	9.94	11.38	24.14	55.17	
05360	-12.32	13.41	16.10	20.69	37.93	
05500	-7.07	8.81	10.97	34.48	58.62	
05640	-5.13	8.94	11.10	31.03	65.52	
05770	-3.69	9.61	12.10	31.03	62.07	
05910	-5.64	7.28	9.21	40.00	60.00	
05985	0.15	10.13	12.41	31.03	62.07	
06096	-5.54	7.33	9.75	48.00	68.00	
06104	-3.61	7.29	9.59	41.38	82.76	
06110	-7.21	9.83	12.36	31.03	62.07	
06124	-10.95	13.08	16.63	25.00	42.86	
06160	-3.62	8.23	10.63	44.83	65.52	
MEAN:	-6.56	10.31	12.67	30.49	56.54	

Relative Humidity Month no. 4						
18 UTC	ME	MAE	RMSE	HR 5	HR 10	
05050	-7.60	11.79	14.55	24.14	55.17	
05090	-12.36	13.43	15.84	17.24	34.48	
05170	-8.03	12.29	15.16	31.03	44.83	
05360	-13.75	15.50	18.26	6.90	48.28	
05500	-3.10	5.69	7.40	51.72	79.31	
05640	-2.77	7.39	9.25	41.38	68.97	
05770	-2.15	8.14	10.95	48.28	75.86	
05910	0.16	5.04	6.72	60.00	80.00	
05985	3.64	8.56	11.41	41.38	75.86	
06096	-3.39	6.75	8.53	40.91	77.27	
06104	-2.56	8.38	11.75	44.83	75.86	
06110	-7.20	8.63	11.60	44.83	72.41	
06124	-11.72	12.10	14.83	32.14	39.29	
06160	0.61	10.61	13.37	31.03	58.62	
MEAN:	-5.02	9.59	12.12	36.84	63.30	

Relative humidity statistics for the 4th month at times 00, 06, 12 and 18 UTC.

Temperature All Months 00 UTC		ME	MAE	RMSE	HR 1	HR 2
05050	0.02	1.33	1.66	46.67	76.67	
05090	-0.42	0.88	1.17	68.33	91.67	
05170	-0.04	0.99	1.31	60.00	87.50	
05360	0.03	0.97	1.26	61.67	89.17	
05500	0.03	1.43	1.74	41.67	73.33	
05640	-0.15	1.33	1.61	44.17	74.17	
05770	0.38	1.50	1.85	42.50	69.17	
05890	0.01	1.65	2.02	37.07	62.93	
05910	-0.19	1.36	1.69	45.83	75.00	
05985	-0.26	1.09	1.34	51.67	85.83	
06096	-0.96	1.19	1.45	43.62	82.98	
06104	0.15	1.27	1.57	41.67	81.67	
06110	0.36	1.35	1.59	42.50	80.83	
06124	0.42	1.39	1.73	44.55	70.91	
06160	0.28	1.39	1.72	41.53	76.27	
06169	-0.44	1.22	1.54	50.83	80.83	
MEAN:	-0.05	1.27	1.58	47.77	78.68	

Temperature All Months 06 UTC		ME	MAE	RMSE	HR 1	HR 2
05050	-0.46	1.05	1.29	57.50	90.00	
05090	-0.54	0.92	1.18	61.67	92.50	
05170	-0.33	0.85	1.15	66.67	90.83	
05360	-0.37	0.98	1.20	60.00	91.67	
05500	-1.05	1.26	1.58	50.00	77.50	
05640	-0.82	1.05	1.33	58.33	87.50	
05770	-0.82	1.05	1.31	55.00	89.17	
05890	-1.60	1.81	2.27	36.97	63.87	
05910	-0.89	1.20	1.47	49.48	81.44	
05985	-0.36	0.84	1.05	70.83	94.17	
06096	-1.00	1.18	1.48	48.94	84.04	
06104	-0.54	0.99	1.30	60.00	87.50	
06110	-0.14	0.93	1.19	62.50	92.50	
06124	-1.42	1.61	1.98	38.89	66.67	
06160	-0.41	1.06	1.34	58.33	85.00	
06169	-0.92	1.47	1.91	42.50	72.50	
MEAN:	-0.73	1.14	1.44	54.85	84.18	

Temperature All Months 12 UTC		ME	MAE	RMSE	HR 1	HR 2
05050	0.46	1.30	1.72	47.90	80.67	
05090	1.00	1.35	1.70	45.00	75.00	
05170	0.65	1.47	1.85	38.33	75.00	
05360	0.71	1.25	1.60	49.17	80.00	
05500	-0.43	1.51	1.86	37.50	71.67	
05640	0.13	1.39	1.79	42.50	76.67	
05770	0.23	1.28	1.63	46.67	79.17	
05890	-0.81	1.70	2.06	33.33	64.17	
05910	-0.06	1.33	1.84	50.00	85.42	
05985	0.28	0.96	1.26	59.17	88.33	
06096	-0.25	1.14	1.48	52.58	84.54	
06104	0.07	1.38	1.74	45.83	75.00	
06110	0.34	1.38	1.73	40.83	79.17	
06124	-0.37	1.49	2.01	47.01	72.65	
06160	0.09	1.29	1.67	47.86	79.49	
06169	-1.90	2.26	2.82	28.33	50.00	
MEAN:	0.01	1.40	1.80	44.50	76.06	

Temperature All Months 18 UTC		ME	MAE	RMSE	HR 1	HR 2
05050	0.32	1.02	1.30	55.93	88.98	
05090	0.84	1.14	1.52	51.69	82.20	
05170	0.81	1.15	1.46	52.54	86.44	
05360	0.64	1.24	1.68	53.39	83.05	
05500	-0.16	1.10	1.36	52.54	88.98	
05640	-0.01	1.12	1.44	50.85	81.36	
05770	0.24	1.09	1.42	55.08	86.44	
05890	-0.26	1.16	1.48	51.69	77.12	
05910	-0.01	1.07	1.50	59.57	84.04	
05985	-0.10	0.91	1.18	66.10	89.83	
06096	-0.10	0.78	1.03	71.74	94.57	
06104	-0.14	1.09	1.44	55.93	84.75	
06110	0.35	0.96	1.22	61.02	93.22	
06124	-0.07	1.03	1.41	62.28	85.09	
06160	-0.02	0.97	1.25	63.25	89.74	
06169	-1.30	1.85	2.36	34.75	59.32	
MEAN:	0.06	1.11	1.44	56.15	84.70	

Temperature statistics for all months at times 00, 06, 12 and 18 UTC.

Relative Humidity All Months						
00 UTC	ME	MAE	RMSE	HR 5	HR 10	
06096	0.90	4.21	6.91	75.00	90.83	
06104	-0.32	3.81	5.58	75.83	91.67	
06110	2.77	5.12	7.15	67.50	89.17	
06124	-0.08	3.66	4.69	82.50	95.83	
06160	-0.30	4.02	5.43	68.33	90.83	
05050	-0.45	3.73	5.24	77.50	94.17	
05090	0.41	5.11	6.85	66.67	86.67	
05170	2.04	5.37	7.17	66.67	84.38	
05360	2.18	5.24	7.23	61.67	90.00	
05500	3.98	5.18	6.28	57.45	91.49	
05640	1.25	3.12	4.80	82.50	93.33	
05770	-0.04	3.64	4.78	72.50	96.67	
05910	-10.87	11.20	12.79	14.55	42.73	
05985	-2.92	3.69	5.72	72.88	88.14	
MEAN:	-0.10	4.79	6.47	67.25	87.56	

Relative Humidity All Months						
06 UTC	ME	MAE	RMSE	HR 5	HR 10	
06096	-3.09	4.96	6.65	63.33	87.50	
06104	-3.41	5.56	7.08	55.00	87.50	
06110	-2.09	4.67	6.30	66.67	85.83	
06124	-3.41	4.51	6.00	66.67	87.50	
06160	-3.30	5.53	7.14	62.50	80.83	
05050	-6.33	6.99	8.65	44.17	74.17	
05090	-0.49	3.79	5.10	75.00	93.33	
05170	-1.65	5.38	7.10	58.76	79.38	
05360	-3.35	5.87	8.10	58.33	81.67	
05500	1.30	4.51	6.07	62.77	87.23	
05640	-4.50	6.01	7.42	47.50	82.50	
05770	-2.45	3.89	5.02	70.00	95.00	
05910	-10.03	10.93	12.61	20.37	43.52	
05985	-4.81	6.35	7.93	47.50	82.50	
MEAN:	-3.40	5.64	7.23	57.04	82.03	

Relative Humidity All Months						
12 UTC	ME	MAE	RMSE	HR 5	HR 10	
05050	-7.92	10.22	12.72	28.57	56.30	
05090	-11.62	12.39	14.53	15.83	42.50	
05170	-5.50	9.90	12.03	29.17	58.33	
05360	-9.01	10.18	12.86	30.00	60.00	
05500	-6.99	9.92	12.32	30.83	56.67	
05640	-6.08	9.82	11.99	28.33	54.17	
05770	-5.34	9.09	11.29	34.17	61.67	
05910	-0.76	7.53	9.53	41.67	73.96	
05985	-5.53	9.29	11.31	34.17	61.67	
06096	-4.02	6.64	8.37	48.45	76.29	
06104	-2.12	8.01	9.97	38.33	70.83	
06110	-5.37	7.99	9.92	37.50	69.17	
06124	-13.27	14.57	17.24	17.95	34.19	
06160	-5.26	9.16	11.30	35.04	58.97	
MEAN:	-6.34	9.62	11.81	32.14	59.62	

Relative Humidity All Months						
18 UTC	ME	MAE	RMSE	HR 5	HR 10	
05050	-4.91	8.48	10.89	33.90	69.49	
05090	-9.44	10.77	13.51	27.97	50.85	
05170	-5.67	9.66	12.25	34.75	56.78	
05360	-8.46	10.16	13.56	34.75	61.02	
05500	-3.83	8.21	10.57	41.53	68.64	
05640	-3.33	8.33	10.48	40.68	64.41	
05770	-2.80	8.90	11.27	36.44	65.25	
05910	-0.03	8.05	10.31	41.49	65.96	
05985	-0.93	6.92	9.08	50.00	77.97	
06096	-3.03	6.05	7.80	53.26	78.26	
06104	-0.85	7.46	10.59	46.61	79.66	
06110	-5.72	8.24	10.28	38.14	66.95	
06124	-12.87	13.77	16.14	18.42	32.46	
06160	-1.84	7.69	10.70	47.86	76.07	
MEAN:	-4.55	8.76	11.24	38.98	65.27	

Relative humidity statistics for all months at times 00, 06, 12 and 18 UTC.

Temperature Month no. 1 All Hours		ME	MAE	RMSE	HR 1	HR 2
05050		-0.50	1.09	1.38	54.62	84.03
05090		-0.02	1.21	1.51	49.58	79.83
05170		-0.37	1.18	1.47	50.42	85.71
05360		-0.27	1.05	1.36	57.98	88.24
05500		-1.16	1.57	1.97	37.82	68.91
05640		-1.23	1.60	1.93	34.45	66.39
05770		-0.72	1.35	1.76	46.22	79.83
05890		-1.00	1.33	1.70	49.57	74.78
05910		-1.13	1.49	2.05	43.70	75.63
05985		-0.24	0.97	1.22	57.98	86.55
06096		-0.84	1.22	1.58	47.87	80.85
06104		-0.81	1.30	1.68	49.58	76.47
06110		-0.61	1.25	1.60	50.42	84.03
06124		-1.16	1.62	2.13	42.20	71.56
06160		-0.53	1.24	1.69	55.08	81.36
06169		-1.93	2.02	2.53	31.93	57.14
MEAN:		-0.78	1.34	1.72	47.46	77.58

Temperature 2. Month All Hours		ME	MAE	RMSE	HR 1	HR 2
05050		-0.37	1.06	1.41	60.33	90.08
05090		-0.10	0.87	1.14	64.75	94.26
05170		0.06	1.03	1.39	62.30	87.70
05360		-0.24	0.94	1.16	61.48	94.26
05500		-0.72	1.27	1.53	48.36	81.15
05640		-0.38	1.10	1.36	54.10	86.89
05770		-0.49	1.10	1.32	51.64	85.25
05890		-1.61	1.95	2.34	27.27	55.37
05910		-0.36	1.16	1.40	50.82	83.61
05985		-0.41	0.98	1.25	61.48	89.34
06096		-0.78	1.09	1.39	55.66	85.85
06104		-0.41	1.04	1.32	55.74	89.34
06110		0.17	0.99	1.21	54.10	93.44
06124		-0.68	1.39	1.78	45.69	70.69
06160		-0.55	1.18	1.38	44.17	84.17
06169		-2.57	2.58	3.01	13.93	36.89
MEAN:		-0.59	1.23	1.52	50.74	81.77

Temperature Month no. 3 All Hours		ME	MAE	RMSE	HR 1	HR 2
05050		0.47	1.22	1.57	46.67	82.50
05090		0.34	0.97	1.28	58.33	86.67
05170		0.80	1.14	1.54	51.67	83.33
05360		0.43	1.07	1.39	60.83	85.00
05500		-0.20	1.34	1.63	42.50	75.00
05640		0.46	1.15	1.49	50.00	79.17
05770		0.71	1.25	1.58	50.00	78.33
05890		-0.30	1.51	1.88	40.00	67.50
05910		0.44	1.12	1.44	54.17	84.17
05985		0.11	0.82	1.06	71.67	93.33
06096		-0.57	1.10	1.40	50.60	84.34
06104		0.21	1.24	1.55	44.17	80.83
06110		0.38	1.13	1.42	55.00	85.00
06124		0.19	1.22	1.58	54.87	77.88
06160		0.37	1.18	1.50	54.24	82.20
06169		-0.45	0.97	1.32	65.83	83.33
MEAN:		0.21	1.15	1.48	53.16	81.79

Temperature Month no. 4 All Hours		ME	MAE	RMSE	HR 1	HR 2
05050		0.75	1.33	1.66	46.15	79.49
05090		0.66	1.24	1.66	53.85	80.34
05170		0.60	1.12	1.46	52.99	82.91
05360		1.11	1.39	1.83	43.59	76.07
05500		0.48	1.12	1.40	52.99	86.32
05640		0.30	1.05	1.36	57.26	87.18
05770		0.54	1.22	1.58	51.28	80.34
05890		0.24	1.51	1.94	42.74	70.94
05910		0.62	0.94	1.24	77.27	86.36
05985		0.12	1.03	1.31	56.41	88.89
06096		-0.09	0.89	1.09	61.70	94.68
06104		0.55	1.15	1.52	53.85	82.05
06110		0.99	1.26	1.55	47.01	82.91
06124		0.22	1.29	1.66	50.45	75.68
06160		0.66	1.11	1.45	57.76	82.76
06169		0.46	1.22	1.47	45.30	86.32
MEAN:		0.51	1.18	1.51	53.16	82.70

Temperature statistics for all times (00, 06, and 18UTC) for each month.

Relative Humidity Month no. 1						
All Hours	ME	MAE	RMSE	HR 5	HR 10	
05050	-2.52	5.80	7.25	50.42	83.19	
05090	-4.88	7.19	9.40	48.74	69.75	
05170	-0.69	6.05	8.26	58.82	79.83	
05360	-2.83	4.79	6.35	67.23	84.87	
05500	-0.01	6.77	9.00	51.26	78.15	
05640	-0.55	6.44	8.63	55.46	73.11	
05770	0.74	5.94	8.31	61.34	76.47	
05910	4.08	7.28	9.62	52.10	70.59	
05985	-2.25	6.63	9.11	56.30	77.31	
06096	-0.33	4.99	6.71	63.83	84.04	
06104	2.48	6.09	8.11	52.94	78.99	
06110	-0.53	4.86	6.21	57.98	89.92	
06124	-8.68	10.61	13.08	31.19	46.79	
06160	-2.18	5.59	7.27	55.93	81.36	
MEAN:	-1.30	6.36	8.38	54.54	76.74	

Relative Humidity 2. Month						
All Hours	ME	MAE	RMSE	HR 5	HR 10	
05050	-2.69	5.38	7.67	59.50	83.47	
05090	-5.09	6.57	8.48	47.54	76.23	
05170	-2.18	7.19	9.45	45.90	72.13	
05360	-4.36	5.94	7.92	58.20	81.15	
05500	-6.65	7.56	10.40	50.82	68.85	
05640	-6.86	8.09	10.33	40.16	65.57	
05770	-1.45	5.60	7.41	57.38	84.43	
05910	-0.21	5.87	7.60	55.74	83.61	
05985	-3.75	6.65	8.87	53.28	76.23	
06096	-0.08	5.25	6.60	61.32	86.79	
06104	-2.11	5.42	6.89	54.10	85.25	
06110	-4.49	6.07	7.83	52.46	77.87	
06124	-13.77	14.04	15.80	9.48	30.17	
06160	-3.74	6.24	8.57	54.17	77.50	
MEAN:	-4.10	6.85	8.84	50.00	74.95	

Relative Humidity Month no. 3						
All Hours	ME	MAE	RMSE	HR 5	HR 10	
05050	-4.71	7.27	9.85	47.50	73.33	
05090	-6.64	8.59	11.67	45.00	66.67	
05170	-5.03	7.77	10.46	48.33	72.50	
05360	-6.03	8.04	11.66	50.00	73.33	
05500	-4.52	7.58	9.75	46.67	70.83	
05640	-5.72	7.90	10.16	42.50	70.00	
05770	-6.39	8.32	10.54	38.33	67.50	
05910	-3.59	6.68	8.77	49.17	73.33	
05985	-2.19	6.32	7.93	46.67	81.67	
06096	-0.24	6.15	7.55	45.78	81.93	
06104	-3.80	7.00	10.04	51.67	77.50	
06110	-4.15	6.18	8.06	53.33	80.83	
06124	-13.65	14.08	16.14	8.85	33.63	
06160	-5.87	7.31	10.26	50.00	74.58	
MEAN:	-5.18	7.80	10.20	44.56	71.26	

Relative Humidity Month no. 4						
All Hours	ME	MAE	RMSE	HR 5	HR 10	
05050	-5.08	9.43	12.84	43.59	64.10	
05090	-8.17	10.21	13.39	33.33	59.83	
05170	-2.54	8.31	10.86	45.30	65.81	
05360	-7.74	9.75	12.99	38.46	64.96	
05500	-3.14	5.71	7.64	54.70	79.49	
05640	-2.97	6.38	8.38	52.99	78.63	
05770	-1.06	7.01	9.60	55.56	78.63	
05910	-3.18	6.02	7.52	50.00	77.27	
05985	0.63	7.73	10.23	47.86	76.07	
06096	-1.19	6.13	7.98	48.94	79.79	
06104	-2.80	6.08	8.69	56.41	84.62	
06110	-4.35	6.62	9.33	54.70	79.49	
06124	-10.92	11.79	14.27	22.52	42.34	
06160	-3.04	7.74	10.28	43.10	72.41	
MEAN:	-3.97	7.78	10.28	46.25	71.67	

Relative humidity statistics for all times (00, 06, and 18UTC) for each month.

Temperature		ME	MAE	RMSE	HR 1	HR 2
All months	All Hours					
06096		0.08	1.17	1.51	51.99	8407
06104		0.22	1.07	1.41	56.69	8536
06110		0.27	1.12	1.47	54.39	8494
06124		0.25	1.11	1.45	56.07	8598
06160		-0.40	1.32	1.65	45.40	7782
06169		-0.21	1.22	1.55	48.95	7992
05050		0.01	1.23	1.57	49.79	8096
05090		-0.67	1.58	1.98	39.75	6702
05170		-0.29	1.24	1.63	51.17	8146
05360		-0.11	0.95	1.21	61.92	8954
05500		-0.58	1.07	1.38	54.11	8647
05640		-0.12	1.18	1.52	50.84	8222
05770		0.23	1.16	1.45	51.67	8640
05890		-0.36	1.38	1.80	48.33	7394
05910		-0.02	1.18	1.51	52.75	8263
05985		-1.14	1.70	2.21	39.12	6569
SUM		-0.18	1.23	1.58	50.81	8090

Relative Humidity		ME	MAE	RMSE	HR 5	HR 10
All months	All Hours					
05050		-3.74	6.95	9.64	50.31	7610
05090		-6.18	8.12	10.88	43.72	6820
05170		-2.61	7.33	9.80	49.58	7259
05360		-5.23	7.11	10.07	53.56	7615
05500		-3.61	6.92	9.27	50.84	7427
05640		-4.05	7.21	9.43	47.70	7176
05770		-2.05	6.71	9.03	53.14	7678
05910		-0.11	6.57	8.63	52.22	7598
05985		-1.91	6.83	9.06	51.05	7782
06096		-0.46	5.60	7.20	55.44	8329
06104		-1.56	6.14	8.50	53.77	8159
06110		-3.38	5.93	7.93	54.60	8201
06124		-11.80	12.66	14.90	17.82	3808
06160		-3.71	6.71	9.17	50.85	7648
MEAN:		-3.60	7.20	9.54	48.90	7365

Relative humidity and temperature statistics for all times (00, 06, 12, 18 UTC) and all months